City of Tulsa

MOBILITY

INNOVATION STRATEGY

March 2022

INCOG

CITY OF TULSA OKLAHOMA

Stantec

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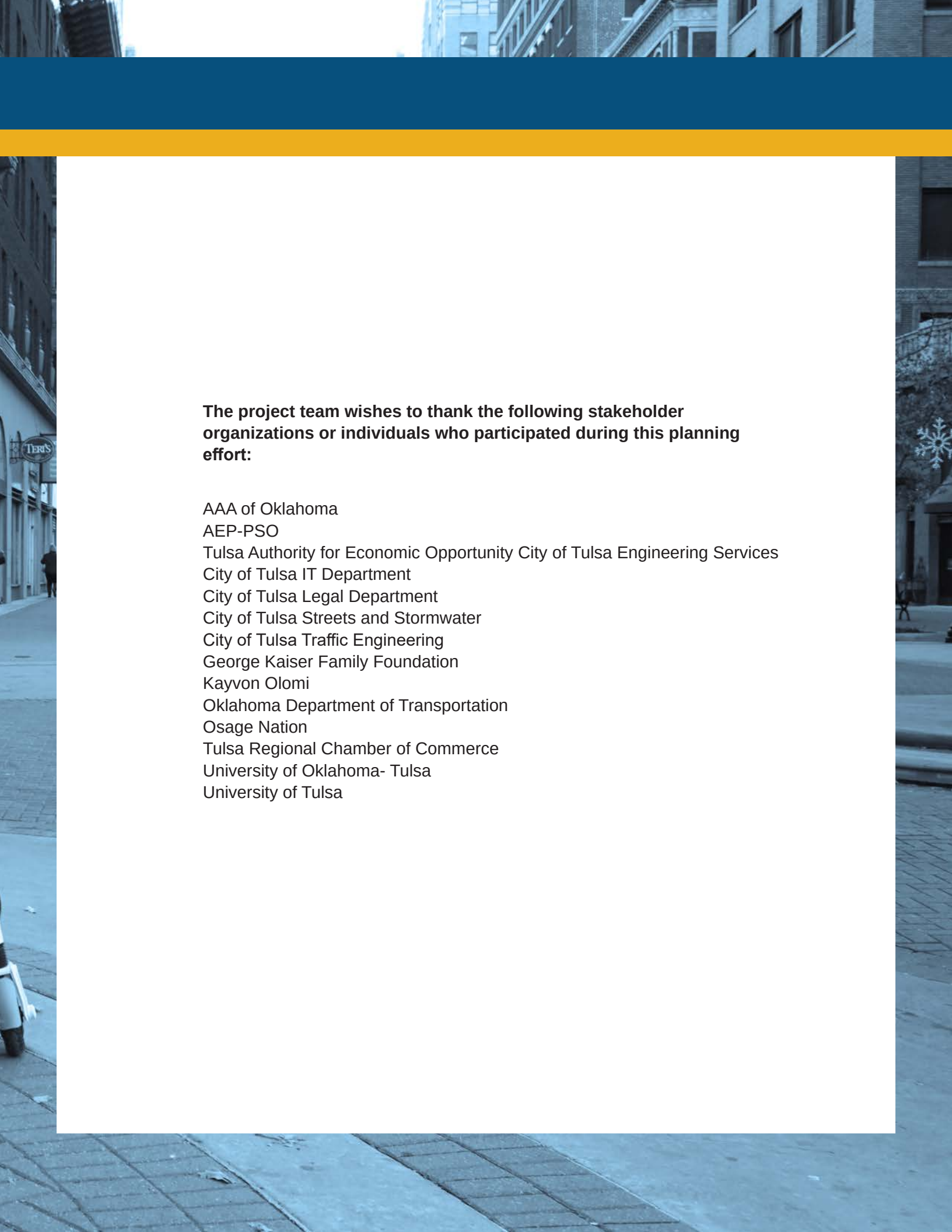

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University of Tulsa

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MAPS

GLOSSARY AND ABBREVIATIONS

The Americans with Disabilities Act (ADA)- A 1990 civil rights act that prohibits discrimination of people with disabilities.

Artificial Intelligence (AI)- Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition, and machine vision.

Automated Vehicles (AV)- Automated vehicles use technology to steer, accelerate, and brake with little to no human input.

Automated Program Interfaces (API)- A software intermediary that allows two applications to talk to each other.

Bus Rapid Transit (BRT)- Bus-based transit service with enhanced reliability and capacity over traditional bus service.

Business Improvement District (BID)- A defined area within which businesses are required to pay an additional tax (or levy) in order to fund projects .

The Coronavirus Aid, Relief, and Economic Security Act (CARES Act)- A Federal economic stimulus bill passed in March 2020 in response to the economic fallout of the COVID-19 pandemic.

Congestion Mitigation and Air Quality (CMAQ)- A Federal program which provides funds to States for transportation projects designed to reduce traffic congestion and improve air quality, particularly in areas of the country that do not attain national air quality standards.

Department of Transportation (DOT)- Either a U.S. or State-level agency which oversees the maintenance and funding of transportation-related infrastructure and improvement projects, dependent upon jurisdiction.

Electric Vehicles (EV)- A vehicle that uses one or more electric motors for propulsion.

Federal Highways Administration (FHWA)- An agency which provides stewardship over the construction, maintenance, and preservation of the Nation's highways, bridges and tunnels. FHWA also conducts research and provides technical assistance to state and local agencies to improve safety, mobility, and to encourage innovation.

Federal Transit Administration (FTA)- An agency within the United States Department of Transportation that provides financial and technical assistance to local public transportation systems.

Geographic Information System (GIS)- A conceptualized framework that provides the ability to capture and analyze spatial and geographic data.

Highly Automated Vehicles (HAV)- These offer the potential to significantly reduce vehicle crashes by perceiving a dangerous situation before the crash has occurred and supporting the human driver with proactive warnings and in some cases active interventions to avoid or mitigate the crash.

Highway Safety Improvement Program (HSIP)- A Federal aid program with the purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads.

Indian Nations Council of Government (INCOG)- The Indian Nations Council of Governments (INCOG) is a voluntary association of local and tribal governments in the Tulsa metropolitan area in northeast Oklahoma. INCOG provides planning and coordination services to assist in creating solutions to local and regional challenges in such areas as comprehensive planning, transportation, community and economic development, environmental quality and energy programs, public safety, and services for older adults.

Level of Service (LOS)- A qualitative measure used to relate the quality of motor vehicle traffic service.

Memorandum of Understanding (MOU)- A legal document describing a bilateral agreement between parties. It expresses a convergence of will between the parties, indicating an intended common line of action rather than a legal commitment.

Mixed-Use- An area or development with a good balance of different land uses, which allows people to access daily needs within closer proximity of one another.

Mobility as a Service (MaaS)- Delivery of seamless, infinitely adaptable, on-demand mobility services through an integrated digital platform across all available modes of transportation.

Metropolitan Planning Organization (MPO)- The policy board of an organization created and designated to carry out the metropolitan transportation planning process.

Mobility Data Specification (MDS)- A digital tool that helps cities to better manage transportation in the public right of way. It allows cities to share and validate policy digitally, enabling vehicle management and better outcomes for residents.

Mobility on Demand (MoD)- Technology that aggregates all modes and manages trip supply and demand by using connected data.

National Association of City Transportation Officials (NACTO)- An association of 91 major North American cities and transit agencies formed to exchange transportation ideas, insights, and practices and cooperatively approach national transportation issues.

Office of Performance Strategy and Innovation (OPSI)- The City of Tulsa's current data policy task force.

Oklahoma State University (OSU)

Public-Private-Partnership (PPP, or P3) or Public-Private-Philanthropic Partnership (P4) - An arrangement between two or more public and private sectors of a long-term nature. Typically, it involves private capital financing government projects and services up-front, and then drawing profits from taxpayers and/or users over the course of the PPP contract.

Proof of Concept- Evidence, typically derived from an experiment or pilot project, which demonstrates that a design concept, business proposal, etc., is feasible.

Request for Proposal (RFP)- A project announcement posted publicly by an organization indicating that bids for contractors to complete the project are sought.

Return on Investment (ROI)- A profitability metric used to evaluate how well an investment has performed.

Subject Matter Expert (SME)- A person who is an authority in a particular area or topic.

Transportation Network Companies (TNCs)- Companies that connect users to transportation services (e.g., Uber, Lyft). Also known as ride-share companies.

Transportation Alternatives Program (TAP)- A funding source for supporting non-driving transportation modes.

Transportation Demand Management (TDM)- Information, encouragement, and incentive programs to complement infrastructure improvements and change transportation decision-making.

Transportation Management Area (TMA)- An organization that executes transportation demand management, usually for a specific business center or employer.

Tulsa Young Professionals (TYPROS)- An organization founded as an initiative of the Tulsa Regional Chamber to attract and retain young, creative talent to the Tulsa region, while also developing the next generation of leaders and enhancing Tulsa's sense of place.

University of Oklahoma (OU)

University of Tulsa (TU)

Unmanned Aerial Vehicle (UAV)- A military aircraft that is guided autonomously, by remote control, or both, and that carries sensors, target designators, offensive ordnance, or electronic transmitters designed to interfere with or destroy enemy targets

Vehicle-to-Everything (V2X)- A technology that allows vehicles to communicate with moving parts of the traffic system around them.

1. INTRODUCTION

Through its Mobility Innovation Strategy, the City of Tulsa and its local partners seek to build economic opportunity, eliminate inequity, and foster sustainability by harnessing new opportunities presented by emerging and traditional mobility technologies.

INTRODUCTION

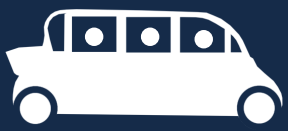
1.1 VISION

The City of Tulsa seeks to convert its streets, neighborhoods, and campuses into **engines of innovation.** By creating a network of transit, biking, walking, shared rides and shared cars, microtransit, and even autonomous vehicles, the City will connect Tulsan to jobs, health care, education, and recreation. This mobility network will elevate Tulsa as a hub of mobility innovation. Furthermore, embracing these alternatives can elevate the City as a regional hub of mobility innovation, thereby attracting new talent, employers, and related jobs in this rapidly evolving and exciting field.

Tulsans have put the **building blocks in place** to make this innovation possible by working closely with government and industry to establish a strong existing backbone of physical and data infrastructure. The City is committed to working with its partners to accelerate the growth of this infrastructure with pilots, policies, and programs that will advance smart mobility solutions and help Tulsa become more prosperous, equitable, and resilient. Tulsa and its partners in business and academia have put many of the building blocks of innovation in place for a digitally connected, multimodal system providing a range of transportation options. These options include public transportation, on-demand and shared services, micromobility, and ride hailing, all of which could be automated and emission-free.

1.2 OBJECTIVES

The Mobility Innovation Strategy focuses on the following objectives.

 IMPROVE EQUITY	Ensure access to convenient transportation to all Tulsans, especially for low-income, unbanked, and those with disabilities. Expand access to employment corridor, such as the Workforce Express Network (WEN) • Implement more transportation services in areas with limited or lacking service (a.k.a. “mobility deserts”) • Create greater access to healthy food options • Remove mobility barriers between neighborhoods
 PROVIDE TRANSPORTATION OPTIONS	Embrace mobility technologies to expand access to transportation choices. • Implement initiatives to increase access to biking and walking options, in addition to first/last-mile transit solutions • Adapt infrastructure to create integrated multimodal transportation and support transition to automated and electric transportation as those options become more viable • Create partnerships that promote shared mobility • Develop a Mobility Lab to implement pilots around curbside, e-cargo, e-shuttle, smart parking, and connected/automated circulators
 PROMOTE ECONOMIC DEVELOPMENT	Strengthen Tulsa’s mobility ecosystem to deepen the talent pool and attract new employers. • Recruit from targeted talent pools and enhance training to existing residents to deepen the skills of Tulsa’s workforce • Attract technology firms to hubs of innovation strategically planned throughout Tulsa that mesh with next generation land use planning

1.3 STUDY METHODOLOGY

This Mobility Innovation Strategy (MIS) study involved seven key tasks that included: a series of kick-off meetings with the City and its public and private partners; mobility and socioeconomic data being gathered, analyzed, and mapped; development of an outreach plan, online survey, and project website, with several outreach events conducted in the winter of 2019-2020; and the development of a framework of recommendations based on detailed assessments of existing planning and policy documents, identified mobility needs, stakeholder input, current and proposed laws and regulations related to smart mobility, and existing economic assets pertinent to smart mobility.

STUDY PROCESS

	1.0	2.0	3.0	4.0	5.0	6.0	7.0
TASKS	Urban mobility problem statements	Assessment of state and local statues	Development of new potential legal framework	Assessment and recommended action plan for technology integration	Economic development assessment and strategy	Research and development opportunities to leverage local talent	Action Plan / Report
INPUTS / DATA	Online Survey City Policies/Prior Plans Technical Interviews Roadshow	Best Practices National Survey Federal/State Laws City/MPO Interviews Tulsa New Mobility Services	Assessment of Existing Mobility Policies New Mobility Policy Report	Assessment of Existing Tech Systems Future Technology Platform	Land Use/Real Estate Trends and Future Development Challenges/ Opportunities Framework Cluster Evaluation	Mobility Lab Smart Mobility Installations Stakeholder Feedback	Technical Asssessments Survey Results Best Practices Stakeholder Feedback Existing Conditions Assessment
STAKEHOLDERS	Communications Department Technical Departments (Traffic Systems) Chamber of Commerce The Public	City of Tulsa State and Local Regional Counsel City Policy Staff	City of Tulsa INCOG Steering Committee Tulsa Transit State and Local/Regional Counsel	City of Tulsa INCOG Steering Committee Me3	City of Tulsa INCOG Steering Committee State and Local/Regional Counsel Advisory Committee	City of Tulsa INCOG Steering Committee Local/Regional Companies and Employers	City of Tulsa INCOG Steering Committee

PROJECT TASK DETAILS:

1. URBAN MOBILITY PROBLEM STATEMENTS

Urban mobility problem statements were developed by reviewing prior plans, conducting interviews with City departments and their public and private stakeholders, reviewing results of the online survey, talking with stakeholders during public events, and conducting spatial analyses in a geographic information system (GIS).

2. ASSESSMENT OF STATE AND LOCAL STATUTES

Stakeholders were interviewed and reviews were conducted of: the zoning code, legal requirements, and funding sources. This was combined to generate an evaluation of the current state of the Oklahoma and local legal environments applicable to the deployment of automated vehicles (AVs). A secondary evaluation of other relevant local, State, and Federal laws that impact the operating of new mobility services was conducted.

3. DEVELOPMENT OF NEW POTENTIAL LEGAL FRAMEWORK

Existing mobility policies were reviewed to develop a new potential legal framework for the City. Topics reviewed and addressed in the framework included: a public data clearinghouse, minimum level-of-service (LOS) standards, subsidies to low-income riders for use of AV services, and reduced minimum parking requirements.

4. ASSESSMENT AND RECOMMENDED ACTION PLAN FOR TECHNOLOGY INTEGRATION

In order to develop a technology integration plan, an evaluation was conducted of existing transportation-related technological capabilities, challenges, and plans for the future of mobility. This thorough review offered the means to provide innovative and flexible transportation solutions combined with a vision for the future of mobility in Tulsa.

5. ECONOMIC DEVELOPMENT ASSESSMENT AND STRATEGY

To create a feasible and realistic economic development strategy, existing and potential industry opportunities were identified and assessed. Infrastructure, labor supply-demand characteristics, and available workspace were evaluated to establish an analytical approach to be used in future prioritizing of development opportunities in specific industry clusters.

6. RESEARCH AND DEVELOPMENT OPPORTUNITIES TO LEVERAGE LOCAL TALENT

Several discussions were led by a smart mobility specialist to help identify a virtual collaboration of local innovators and partnerships with local institutions to share and display the latest innovations and strategies. This collaboration helped to deepen the technical knowledge and understanding of potential opportunities, enhancing the framing of the initiatives within this report.

7. ACTION PLAN/REPORT

The final action plan brought together all the technical reports, memos, and analyses developed in the prior tasks to develop the overall strategy for smart mobility efforts for the City. This report includes high-level and supporting strategies along with execution resources such as implementation checklists and case studies.

1.4 CONTEXT

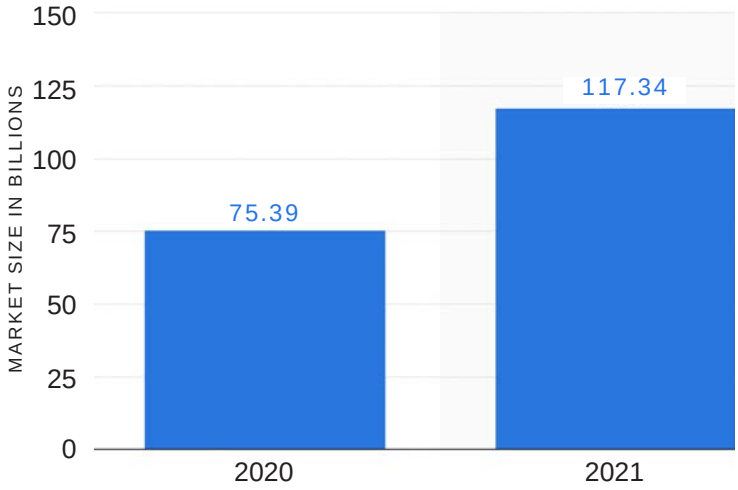
GLOBAL, NATIONAL & STATE TRENDS

The market for smart and electric mobility options is increasing as these technologies become more accessible, affordable, and safe. Tulsa's building blocks leave it poised to take advantage of these persisting trends.

In 2019, the global electric car fleet increased by 2.1 million vehicles from the previous year, registering an annual average growth of 60% for 2014-2019. Oklahoma is surpassing this larger-scale trend. From 2017-2018, electric vehicle (EV) sales in the State increased by 250%; the largest percent increase in sales of EVs for any state in the country for that period.[1] The EV share of automobiles will only continue growing; some experts predict parity between electric and gas-powered vehicle prices by 2023.[2] One forecast projects that there will be almost 875,000 EVs on Oklahoma highways by 2045, comprising nearly half of all vehicles driven, and the state is rising to meet the accompanying infrastructure needs by installing a vast network of EV charging stations.[3] This is evidenced by the fact that Oklahoma ranks second in the nation in installed fast chargers per capita and has sited them every 50 miles along all interstates and most highways in the state.[4]

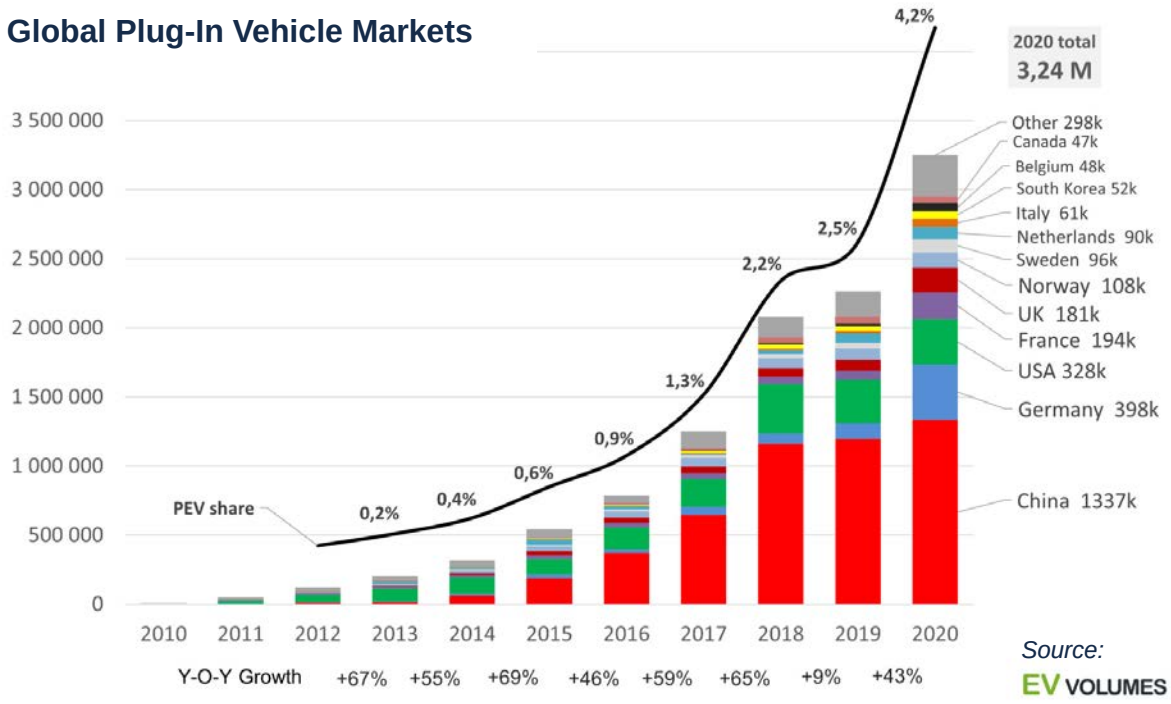
New forms of mobility are also growing. The smart mobility market—which includes digitally connected and shared transportation solutions—will be valued at $400 billion by 2025, or eight to nine times today's value.[5] It also predicts that around 50 percent of all new cars could be equipped with some kind of basic autonomous equipment by the end of 2020.[6] Ride-hailing usage has been growing throughout the world, including the United States; in 2020, prior to the pandemic, 62 percent of Americans reported using ride-hailing services like Uber and Lyft, up from 45 percent in 2017.[7] Meanwhile, Oklahoma seeks to expand citizens' access to ride hailing as well as micromobility options. The state's long-range transportation plan highlights the need to create public-private partnerships (P3s) with transportation network companies (TNCs) that provide ride-hailing services; the plan also supports efforts to expand access to shared micromobility services like Lime and Bird e-scooters or electric bikes in both urban and rural areas.

Ride-sharing Market Size Worldwide in 2020 and 2021



In one year alone, the worldwide ride-sharing market has increased by nearly 35% (Source: Statista)

1 Oklahoma DOT. (2020). (rep.). 2045 Oklahoma Long Range Transportation Plan (p. 56).
2 Ewing, J. (2020, September 20). The Age of Electric Cars Is Dawning Ahead of Schedule. The New York Times.
3 Data from Statista.com
4 Connecting Dots and Bridging Gaps: Alternative Fueling Corridors. (2018, January 16). Retrieved from Alternative Fuels Data Center website: https://afdc.energy.gov/bulletins/technology-bulletin-2018-01.html#/find/nearest?fuel=ELEC&ev_levels=dc_fast
5-6 Smart Mobility- Transport is Getting More Intelligent. UBS. (2021). https://www.ubs.com/global/en/wealth-management/chief-investment-office/investment-opportunities/digital-disruptions/2017/smart-mobility.html.
7 Deloitte. (2020). (rep.). 2020 Global Automotive Consumer Study: Is consumer interest in advanced automotive technologies on the move? (pp. 14–14). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-2020-global-automotive-consumer-study-global-focus-countries.pdf



Electric vehicles continue to increase globally and within the United States.

Tulsa is one of the few cities in the USA that have installed DC Fast Charging EV stations. (Source: Freewire Tech)

THE TULSA CONTEXT

The City is at an exciting and pivotal moment in its growth and evolution. In 2017, the Office of Performance Strategy and Innovation (OPSI) convened a cross-disciplinary collective of engineers, academics, planners, advocates, nonprofits, philanthropic organizations, and business leaders to develop a policy and technical action plan to lower barriers for emerging transportation technology in the City. The Urban Mobility Innovation Team has laid the groundwork for the development of a Mobility Innovation Strategy to harness smart mobility options that solve transportation challenges and establish the City as a leader for the field.

Tulsa is well-situated to embrace smart mobility innovations:

- It has **strong local partners** such as Oklahoma State University (OSU), the University of Oklahoma (OU), and the University of Tulsa (TU) that are eager to develop new lines of research and innovation.
- There are **broadly shared goals** around the importance of both retaining and attracting young talent plus recognizing that new urban mobility solutions are central to improving quality of life.
- The City has an active Chamber of Commerce that is tapped into **local young entrepreneurs.**
- City leadership has an **established dialogue with stakeholders and citizens**. As evidence of this, the City is a 2018 recipient of an Engaged Cities Award by the Cities of Service organization.
- The City has a relatively low congestion and a well-connected street-grid.
- Local industries such as cybersecurity and mechanical and electrical engineering can be tapped for potential **expertise and economies of scale** in developing new local AV and AV-related industries.
- Tulsa has a relatively young population that is more likely to **embrace innovations** and place higher value on a lifestyle less dependent on driving.

The University of Tulsa has been a leader in cybersecurity research and education for over two decades.

The Tulsa Regional Chamber Annual Meeting in 2020 gathered nearly 1,500 attendees.

BUILDING BLOCKS FOR CHANGE

The City is proactively seeking solutions to its challenges and is embracing mobility innovations. Accomplishments and work underway to date include the following:

Mobility as a Service (MaaS)

- The Tulsa Transit GoPass enables payment and trip planning for transit and Transportation Network Companies (TNCs). The GoPass also allows for cash payments at local businesses. Tulsa Transit wants to **integrate other modes**, including e-scooters and bikeshare.

Transit

- The new Peoria Avenue Bus Rapid Transit (BRT) corridor provides **high-frequency, premium service** and a foundation for building a smart mobility spine and citywide high-quality network. A second BRT line will be operational in 2022.
- Tulsa Transit is actively pursuing mobility innovations, including **TNC pilots** to service first- and last-mile connections from fixed route transit service.

Bicycle & Pedestrian

- The City is creating **more bicycle lanes**, particularly in Downtown.
- The City is working towards attaining **Walk Friendly Community** recognition.

Micro-mobility

- This Machine (Tulsa's non-profit bikeshare service) has converted from standard docked bikes to a fleet of **250 dockless e-bicycles.**
- The City works proactively with e-scooter providers and local stakeholders to provide equitable access while creating a **framework for safer operation**.

Transportation & Technology Innovation

- TU has a nation-leading **cybersecurity program** and has taken the lead on creating a Tulsa Cyber District.
- The Tulsa region aims to **pilot autonomous air travel/delivery**, utilizing the Tulsa Drone Airfield and a drone engineering program at OSU.
- The Osage Nation has created a **drone testing facility** on the north side of Tulsa.

Equity

- This Machine provides **social service clients** with free passes.
- Local retailers should sell bus passes to customers.
- Tulsa Transit is implementing a **free fare program** for high school students
- A new City ordinance requires placement of micromobility in underserved areas.

Economic Development

- Leaders in the private sector are implementing a program to provide **relocation incentives** for remote workers; in 2020, 375 people from around the country and the world relocated to Tulsa.
- Tulsa Innovation Labs is developing a **city-wide strategy** that positions Tulsa as a tech hub and leader in the future of workplaces.
- Through code changes and partnership with the Business Improvement District (Downtown Tulsa Partnership), the City is creating more **places for people to dine outdoors** by converting parking spots to "parklets" that boost businesses downtown.

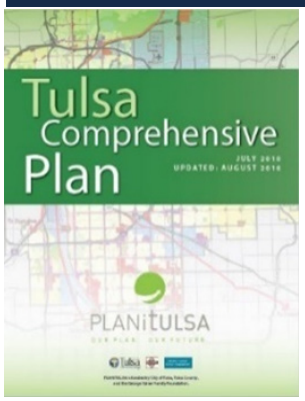
This plan also includes **Practitioner Checklists** in Section 7. The Practitioner Checklists are a detailed resource outlining implementation steps and components of four key recommnded efforts, including grocery store mobility hubs. The checklists provide an overview of necessary elements, partners, operational considerations, and potential funding sources. They also includes sample metrics to measure effectiveness, as well as case studies from other U.S. cities.

Highly-visible bike lanes throughout parts of Tulsa increase the safety of bicycle riders on the road.

PREVIOUS PLANNING PRECEDENTS

The strategy in this report builds off strong planning precedents in greater Tulsa and has incorporated an assessment of recent local and regional planning documents to identify plans, programs, and policies that not only support smart mobility but provide a launch point for the initiatives contained in this report. These planning precedents are briefly referenced below:

Tulsa Comprehensive Plan (PLANiTULSA) —City of Tulsa, 2021



PLANiTULSA is Tulsa's comprehensive plan, providing a vision of how the City will look, function, and feel over the next 20-30 years. First developed in 2009, it was reviewed and updated in 2020-2021.

Relevant Precedents for Mobility Innovation:

- Technology solutions are offered to improve both transit and driving. This includes optimizing traffic signal equipment, improving high-speed communications, and revising the regional intelligent transportation system architecture to focus on transit integration along specific corridors.
- The plan also envisions modernization of funding resources to leverage public and private partnerships for street improvements.

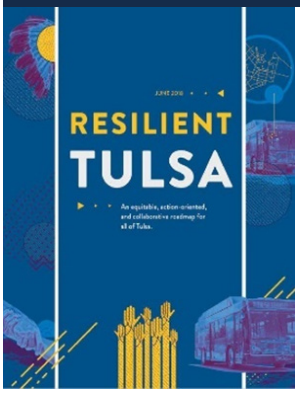
Connected 2045: Regional Transportation Plan—City of Tulsa, 2017

Connected 2045 Transportation Plan (2017) anticipates the Tulsa Transportation Management Area's future transportation needs and envisions long-term transportation improvements to be implemented over the next 25 years.

Relevant Precedents for Mobility Innovation:

- Active transportation priorities focus on safety, connectivity to transit and bikeshare, and equity.
- Transit recommendations focus on improving connections to key destinations, such as for food and shopping.
- The plan recommends utilizing technology, such as online transit payment options, partnerships with TNCs, big data, and smart infrastructure to enable transit services that more easily integrate into daily life.

Resilient Tulsa—City of Tulsa, June 2018

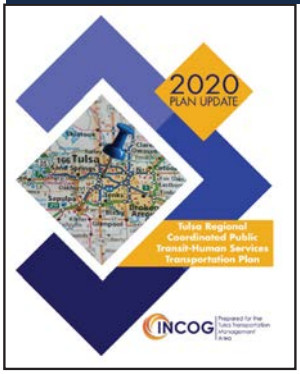


Resilient Tulsa provides a strategy for Tulsa to become a more equitable and resilient city by channeling its historic assets and current growth.

Relevant Precedents for Mobility Innovation:

- The plan's goals and actions support all Tulsans in accessing jobs and food, improving health outcomes, and advancing economic opportunities.
- The plan's economic strategies focus on developing local capacity for jobs of the future, including partnering with local institutions to address industry-specific skills gaps.
- It recommends establishing an Innovation District and Prototyping Zone to attract and retain high-growth industries and world-class jobs.

Tulsa Regional Coordinated Public Transit-Human Services Transportation Plan—INCOG, 2015

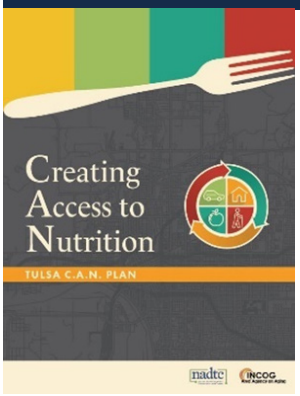


Tulsa's Regional **Coordinated Public Transit-Human Services Transportation Plan** emphasizes the importance of providing economical and sustainable transportation services for disadvantaged populations to reduce potential marginalization.

Relevant Precedents for Mobility Innovation:

- The plan recommends developing a Mobility Management Center to streamline the scheduling and dispatching of all trips.
- It recommends the development and implementation of a Pedestrian Master Plan to assess sidewalks, safe routes to transit, and barriers.

Creating Access to Nutrition (Tulsa CAN Plan)—INCOG, 2019

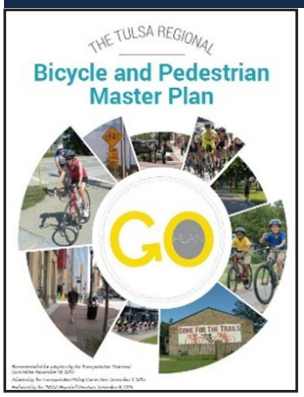


The CAN Plan explores the barriers and challenges that limit North Tulsans' access to healthy food and provides opportunities and recommendations to make improvements. It focuses on people with mobility challenges, especially the elderly and people with disabilities.

Relevant Precedents for Mobility Innovation:

- The plan recommends a pilot program to create a flexible shared shuttle to bring people to supermarkets.
- It suggests public-private partnerships with rideshare companies, food delivery services, and a mobile grocery truck to increase access to healthy food.

GO Plan: The Tulsa Regional Bicycle and pedestrian Master Plan—INCOG, 2015 (2021 amendments)

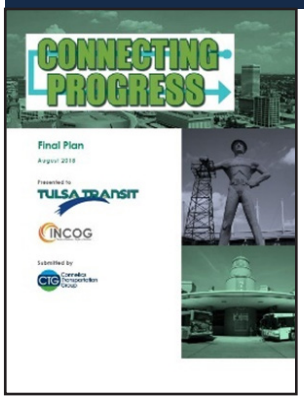


Tulsa's regional **Bicycle and Pedestrian Master Plan** sets forth a strategy to create a more walkable and bicycle-friendly Tulsa.

Relevant Precedents for Mobility Innovation:

- Bike priorities consider areas with low automobile ownership and low-income populations, while pedestrian project priorities seek to increase connectivity to schools, medical destinations, transit stops, and daily shopping needs: 15th Street between Peoria and Utica, East 21st Street and Garnett Road, and the intersection of Highway 169 and East 21st Street.
- Recommendations include an expanded bike share network and technology solutions, such as rectangular rapid flash beacons to protect pedestrians at intersections.

Connecting Progress Plan—Tulsa Transit and INCOG, 2018



The Connecting Progress Plan was undertaken by Tulsa Transit to support its launch of the AERO BRT and to improve the rest of the City's bus network.

Relevant Precedents for Mobility Innovation:

- The plan considers creative approaches to service delivery in low-density areas, such as partnerships with TNCs, on-demand services that are contracted to a private carrier, or flexible routing that allows for deviated fixed-route service or a flex-service zone.
- The Plan's revised bus network increases North Tulsa's access to social services and the BRT.

KEY CHALLENGES IN TULSA

Existing planning and policy documents were reviewed to identify key mobility challenges. Under this study, the extensive community engagement conducted for the Resilient Cities project and other recent planning efforts was augmented with an online survey, public outreach, and stakeholder discussions. The identified challenges were refined through a spatial analysis of transportation and socioeconomic data. The outreach helped to reinforce the City's top priority of achieving resiliency and equity.[1] Each of the top identified mobility challenges have particular significance to people of color, the elderly, and those with disabilities. Other impacted groups include those who are unbanked, unemployed, under-employed, or who work in low wage jobs. Tulsa's main challenges in mobility equity are as follows:

1 City of Tulsa, 100 Resilient Cities. (2018). Resilient Tulsa. Retrieved from https://www.cityoftulsa.org/media/7673/reslient-tulsa-digital-web.pdf

Source: Oklahoma Farm and Food Alliance

Public markets like these in Tulsa provide an important alternative solution for healthy food access.

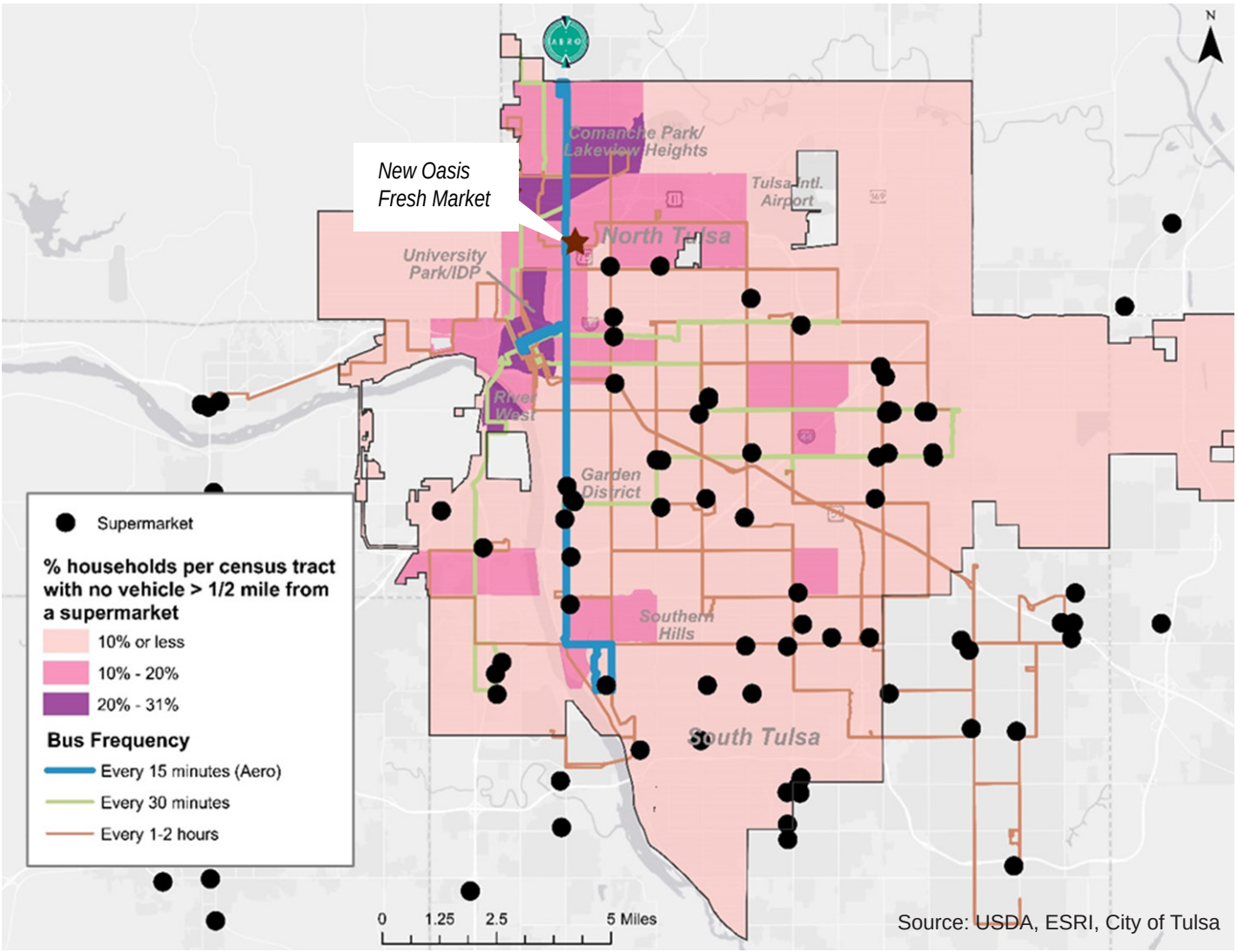
IMPROVING EQUITY IN TULSA

Mobility innovation in Tulsa needs to advance equity. While equity should naturally hover near the core of any mobility improvement effort, historic inequities in Tulsa remain and must be directly addressed to successfully build a complete and resilient mobility ecosystem. Therefore, any finding or recommendation of this Mobility Innovation Strategy should be considered through the lens of equity, carefully integrating measures and solutions that tackle known problems, such as those listed below.

Parts of the City Lack Convenient Access to Healthy Food Options

Transportation barriers prevent many Tulsans–especially low-income, elderly and people with disabilities–from convenient access to fresh food options. Large **swaths of the city are not within walking distance of a supermarket** and lack convenient access by any mode to affordable fresh produce. Tulsa's 2019 CAN Plan provides recommendations for improving access to food, and organizations like Tulsa Transit (through The Lift), health services organizations, and residential communities offer free or subsidized shuttle connections for neighborhoods in need. However, **many more options are needed** to reach equitable food access.

Map 1. Supermarkets, Concentrations of Households with No Vehicle and Transit



Tulsa Speaks

50% of survey respondents don't use their own vehicle to access the supermarket

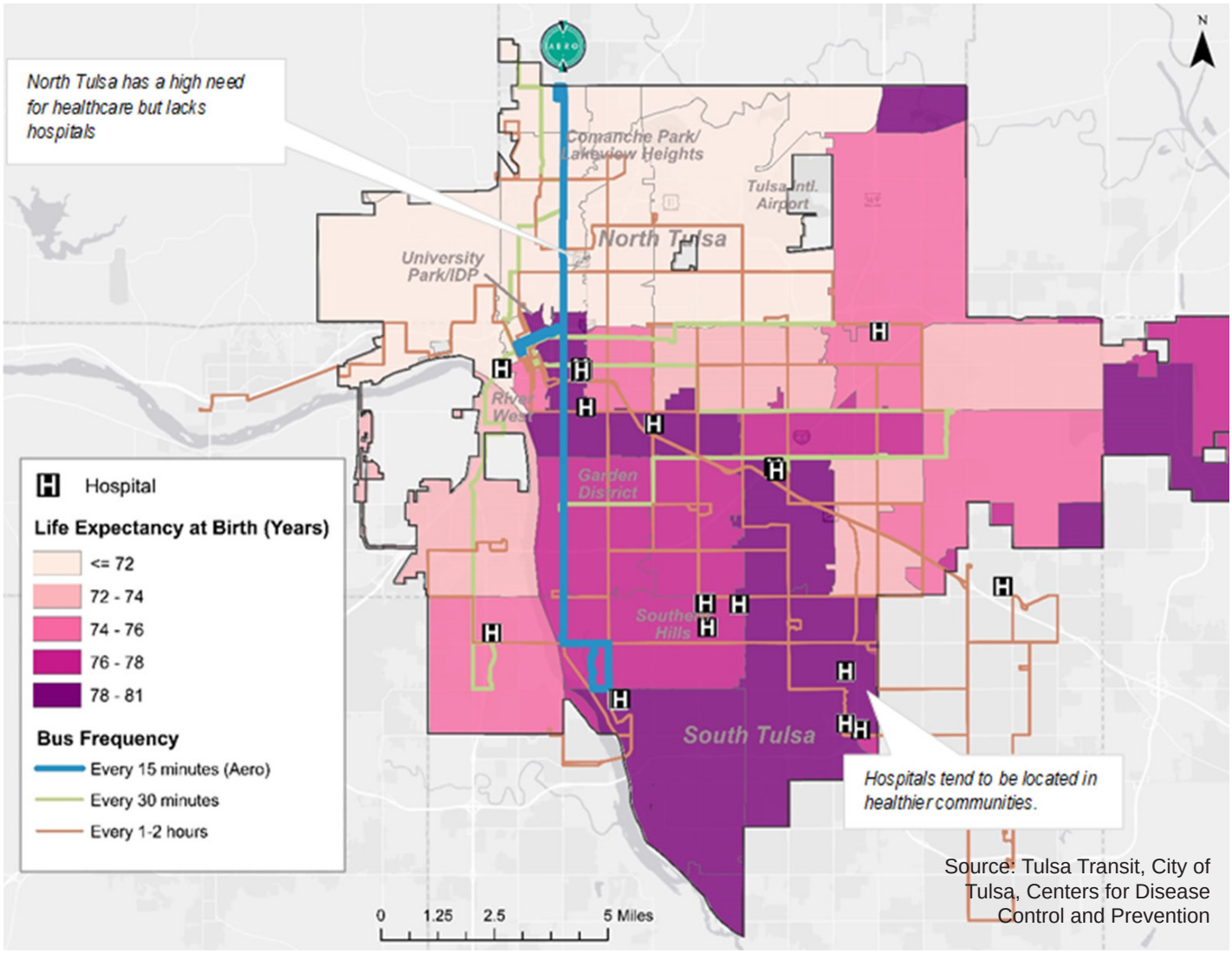
55% said they had difficulty buying food either always or some of the time

Source: Tulsa CAN Plan 2019

Transportation Barriers Hinder Tulsans from Accessing Healthcare

Many households in neighborhoods such as North Tulsa are unable to afford a car and must **rely on transit service to access medical facilities.** Last-mile connections from stops to healthcare often lack pedestrian infrastructure along the road and can represent an uncomfortable or even impossible barrier to the elderly, families with young children, vulnerable people traveling alone, etc. The Lift and other scheduled shuttles address some of the City's needs, but **significant city populations must travel far for quality care**. In the wake of COVID-19, new solutions such as telehealth could be supported to aid in this solution, with appointments conducted over connected tablets delivered to patients by AV.

Map 2. Life Expectancy & Hospital Locations in Geographic Regions of Tulsa



Source: Tulsa Transit, City of Tulsa, Centers for Disease Control and Prevention

Major Job Growth Areas Are Not Well Connected to Employee Home Locations

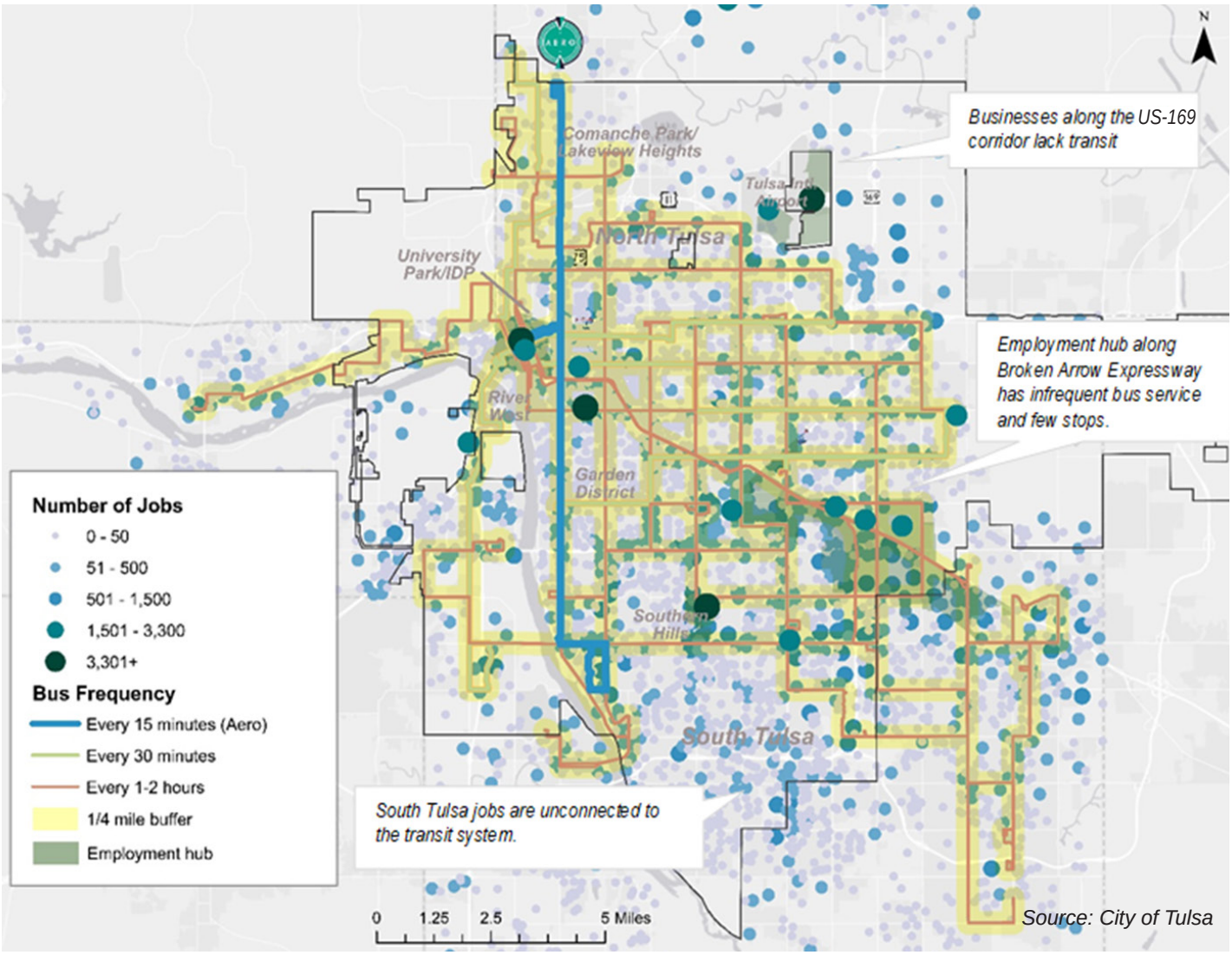
Growing employment hubs such as the US-169 corridor and the Broken Arrow Expressway lay outside the transit system footprint and are lacking in infrastructure to support walking or biking. The **lack of commute options** is ultimately **an economic hardship** since it represents a barrier to job access forcing below median income workers to either rely on informal carpools or purchase vehicles for which they can't afford insurance. Tulsa's Comprehensive Plan, Plan-It-Tulsa, envisions expanding the transit system and creating a multimodal street system to enhance commutes. The new Aero BRT is an important first step.

Tulsa Speaks

37% say that commuting by transit takes too long
24% say that transit stops are located too far from work
26% don't bike to work due to lack of bike lanes and paths
26% say it's too far to bike to work
77% say it's too far to walk to work
39% don't walk to work due to a lack of sidewalks

Source: Tulsa CAN Plan 2019

Map 3. Bus Frequency & Job Clusters



Source: City of Tulsa

Students Face Challenges Getting to School

Public school consolidation and cutbacks in school bus service have made it difficult for students to travel to school. Students living less than two miles from their schools are not provided transportation services. **Limited infrastructure and poor first- and last-mile access to transit** mean that students must either face potentially unsafe biking or walking conditions or be driven to school. A variety of groups are working to solve many access problems, including Tulsa Transit's **free fares for high school students** and The Bike Club program.

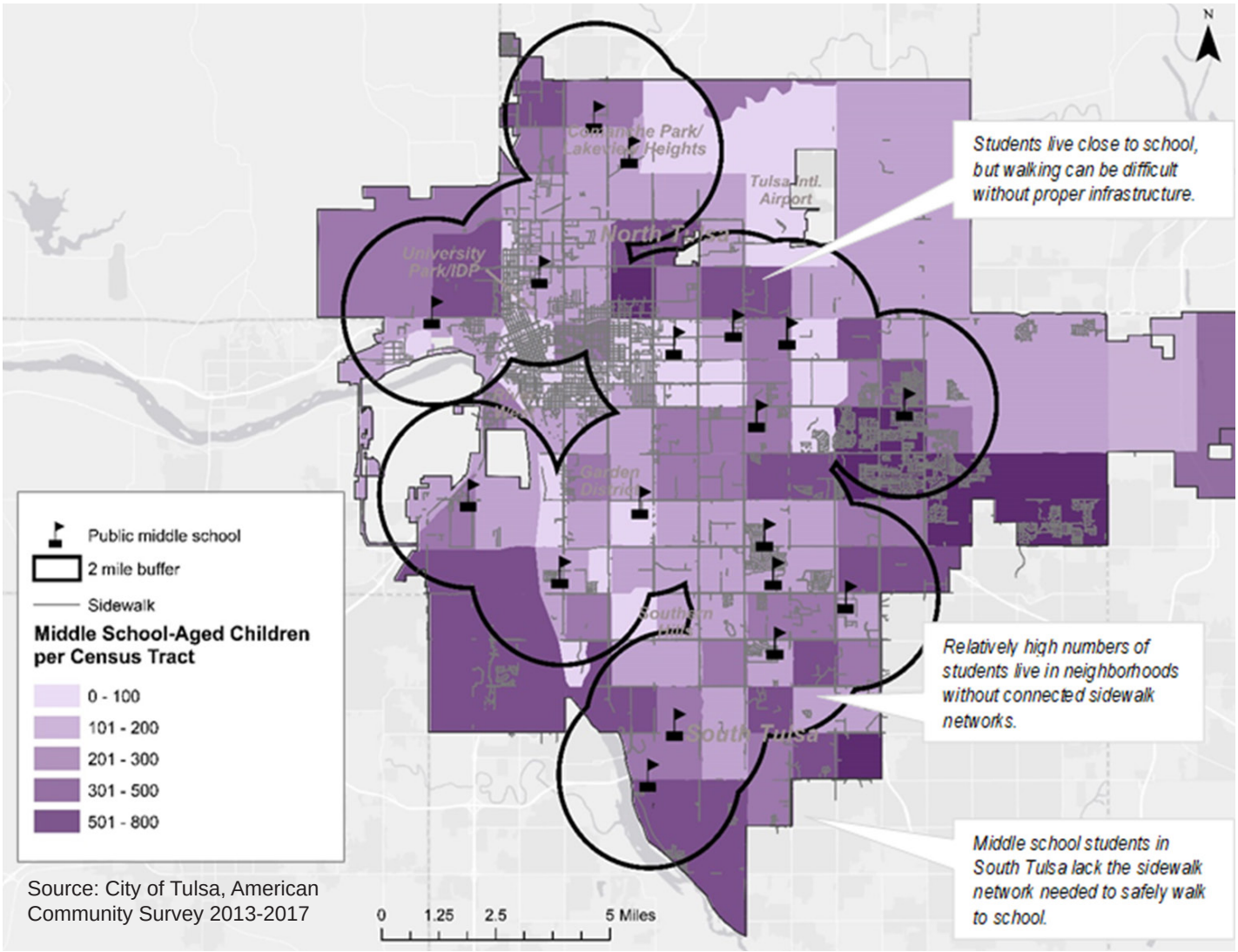
Tulsa Speaks

55% of survey respondents are dissatisfied with their family's choices for walking

53% are dissatisfied with their family's choices for riding a bike

Source: Tulsa CAN Plan 2019

Map 4. Walking Access to Middle Schools



Source: City of Tulsa, American Community Survey 2013-2017

Below Median Income, Especially "Unbanked" Residents, Are Trapped with Limited Mobility Options

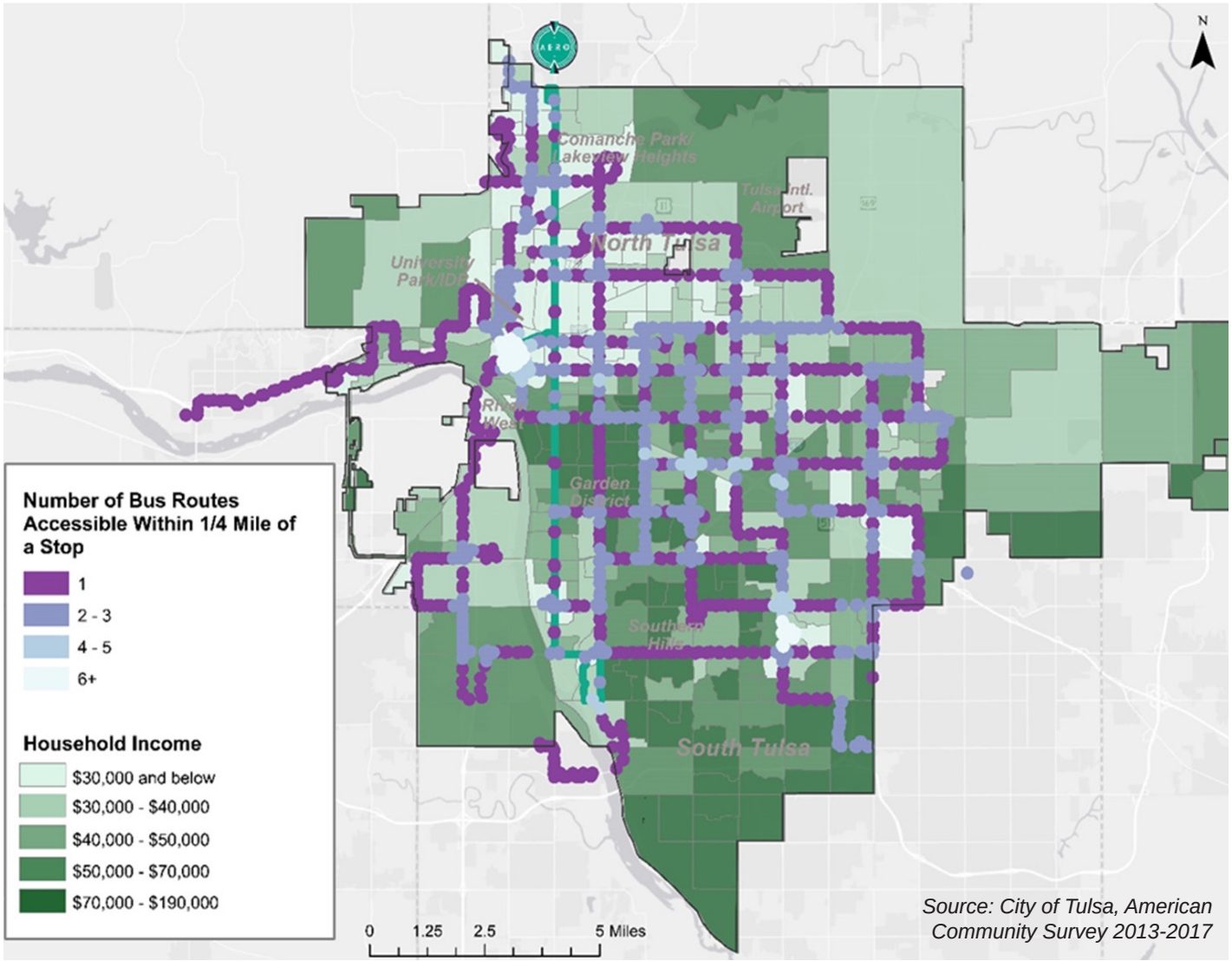
For the nearly 20 percent of Tulsans living in poverty (U.S. Census data), car ownership is over a third of their annual income. Some Tulsans can afford vehicles but not insurance. **Others cannot afford a vehicle** and must rely on informal networks or **long transit, walking, or biking journeys** to get to their destinations. Non-white and low-income communities with limited access to transit are especially burdened. People without access to credit or bank accounts – the "unbanked" – face extra challenges as they cannot access electronic payment systems or mobility apps. Tulsa Transit's partnership with QuikTrip for purchasing bus passes is helping the unbanked, but other partnerships for shared mobility should be explored.

Tulsa Speaks

28% think the cost of owning a car is a #1 transportation challenge
52% think the cost of owning a car is a top-3 transportation challenge

Source: Tulsa CAN Plan 2019

Map 5. Household Income & Transit Accessibility



Source: City of Tulsa, American Community Survey 2013-2017

Poor Last-Mile Connections Make Travel by Transit Challenging

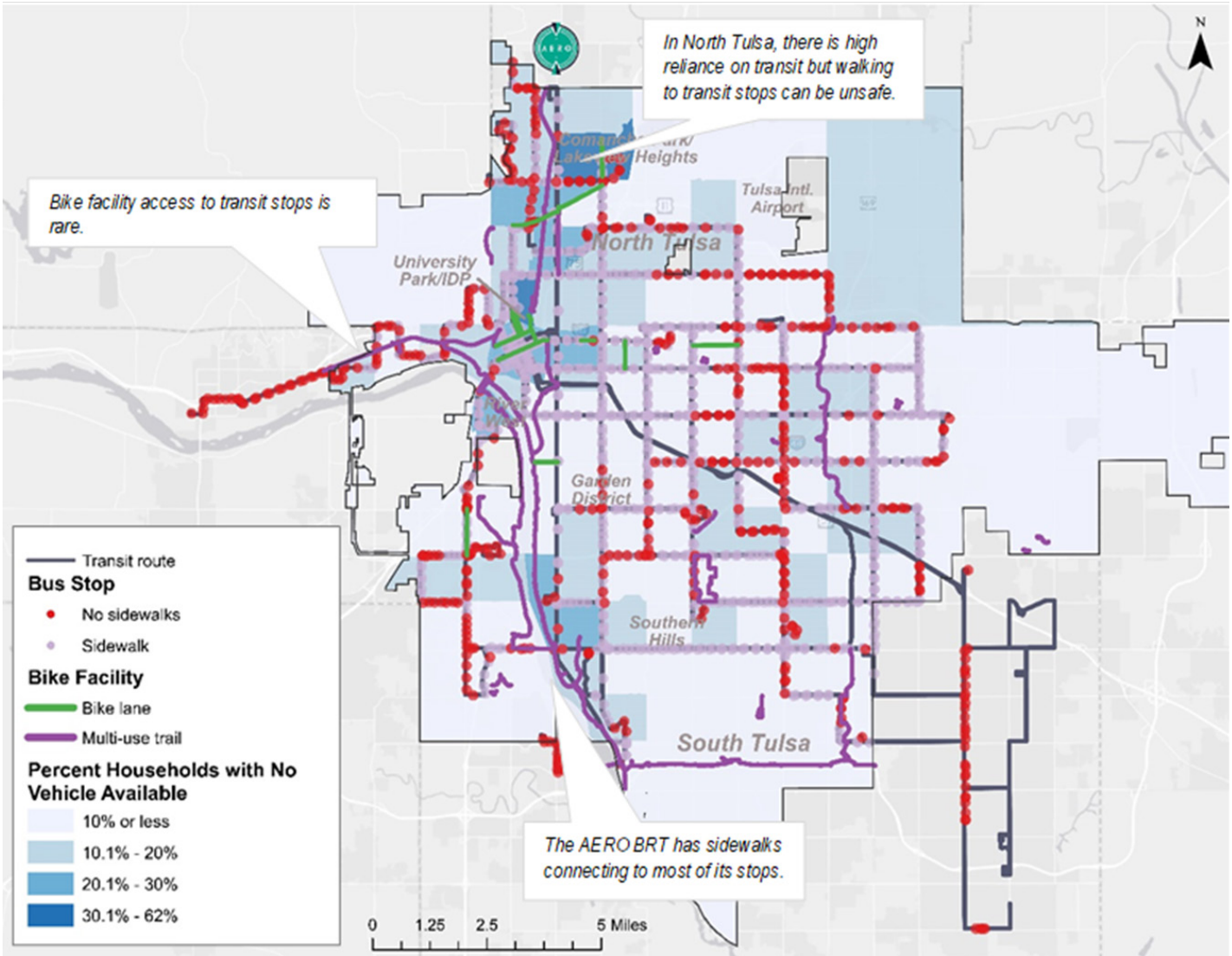
Almost nine percent of households in Tulsa do not have access to a car and rely on transit access to food, schools, and healthcare. However, getting to a nearby bus stop can be challenging, with one-third of Tulsa's bus stops lacking adjacent sidewalks and most lacking biking infrastructure. Tulsa's GO Plan recommends improving the bike and pedestrian network, funding for citywide safe pedestrian crossings, implementing several 2017 walkability analysis recommendations downtown, and an opt-in, mixed-use rezoning incentive program to make new development along the Peoria BRT more walkable. This momentum should continue and expand to truly make transit access equitable throughout Tulsa.

Tulsa Speaks

53% are unsatisfied with their transit access
41% say lack of sidewalks is a top-3 transportation challenge
16% say unsafe crosswalks is a top-3 transportation challenge
21% say lack of bike lanes is a top-3 transportation challenge

Source: Tulsa CAN Plan 2019

Map 6. Bicycle & Pedestrian Access to Transit Service



Existing Transportation Funding Criteria Favor Solutions to Vehicular Congestion Over Other Modes

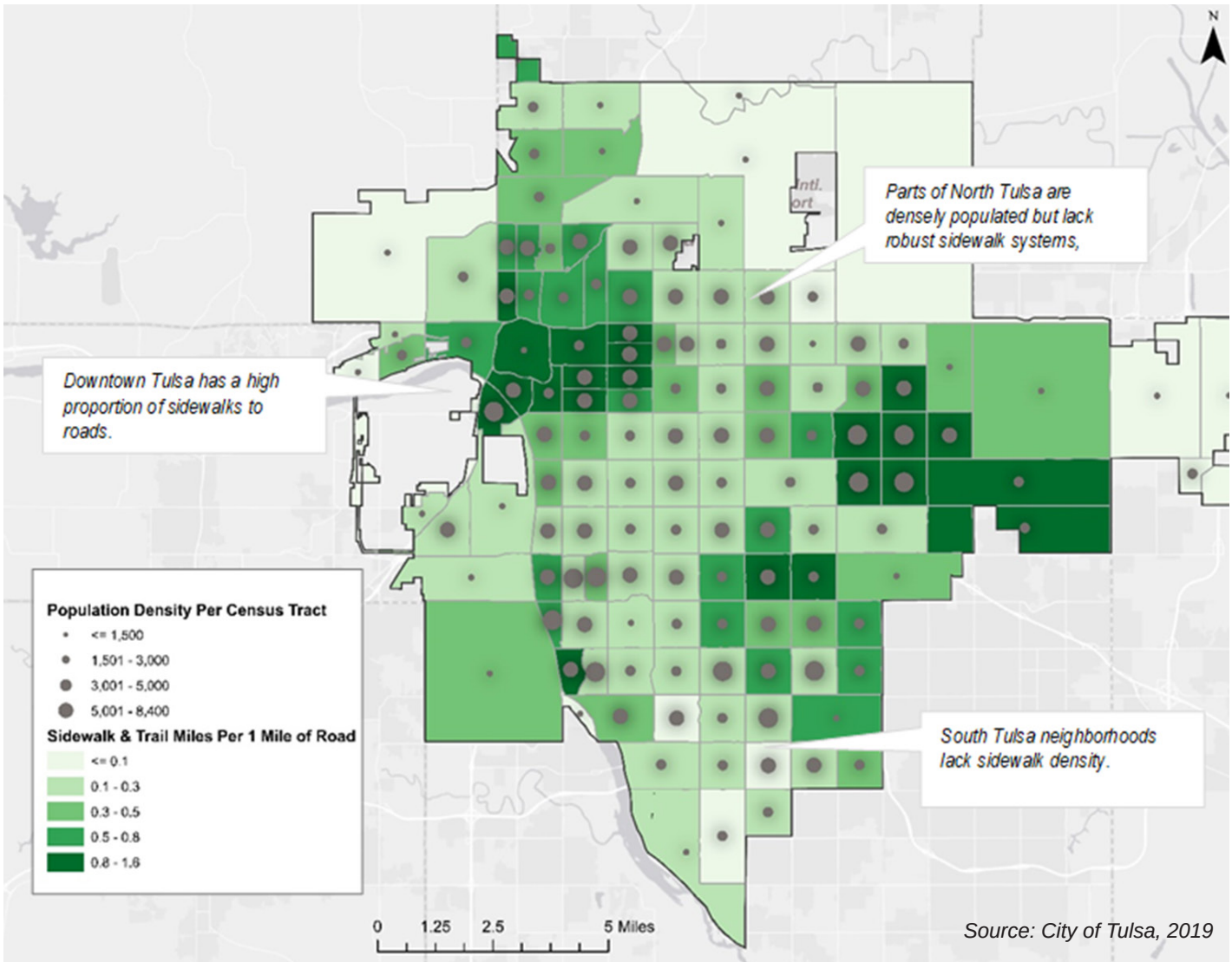
Recent demographic shifts underscore the need to shift funding away from roads and vehicles to transit, walking, and biking. **Tulsa's aging and younger residents are driving less**, whether from necessity or desire. However, transit funding has been flat for years, and most roadway maintenance projects do not seek to install new sidewalks or protect biking facilities. While several current projects from the 2018 walkability study are seeing new bicycle lanes and conversions of one-way roads to safer two-way streets in and near downtown, **extensive gaps remain citywide**.

Tulsa Speaks

41% of respondents are unsatisfied or very unsatisfied with their transit access
43% think that lack of sidewalks is a top-3 transportation challenge
20% think that unsafe sidewalks is a top-3 transportation challenge

Source: Tulsa CAN Plan 2019

Map 7.Sidewalk Density & Where Tulsans Live



Source: City of Tulsa, 2019

Lack of Knowledge Is an Impediment to Widespread Adoption of Technology Innovations

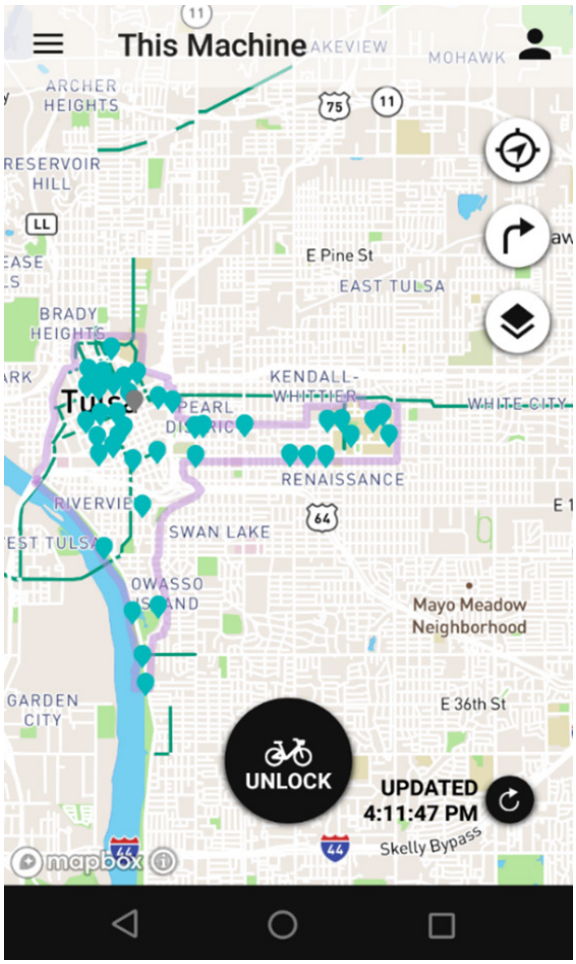
Tulsans reported **high levels of unfamiliarity with various mobility innovations** such as bike share. This is, in part, due to each new mode only providing access via its own app and in limited service areas. Bike share stations and e-scooters are largely clustered around downtown and are not accessible to many Tulsans. Tulsa Transit is working to overcome barriers with a new personal mobility app that will allow users to pay fares, plan trips, and link to additional modes of transportation. In addition, This Machine has expanded docks in some areas beyond downtown. However, many more **Tulsans need to know about these new options** becoming available to them.

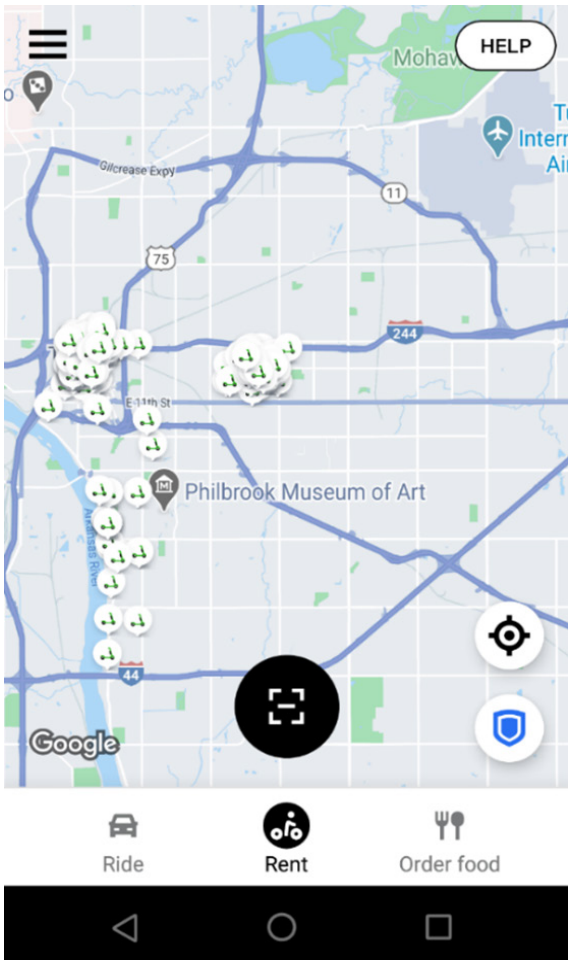
Tulsa Speaks

33% are unfamiliar with autonomous vehicles
44% feel worried or very worried about them
50% are unfamiliar with bike share
23% are unfamiliar with electric scooters

Source: Tulsa CAN Plan 2019

Map 8. Limited Micromobility Service Areas in Tulsa





As evidenced from the services' apps pictured above, bike share and e-scooter options are clustered around downtown Tulsa, the riverfront, and Route 66. Residents living outside of these service areas lack direct access to these options and many are unaware they exist.

2. A MOBILITY INNOVATION STRATEGY FOR TULSA

Tulsa will use its ingenuity and civic resources to harness emerging mobility technologies to build economic opportunities for all Tulsans

A MOBILITY INNOVATION STRATEGY FOR TULSA

2.1 BUILDING ON ACCOMPLISHMENTS

FOCUS ON MOBILITY INNOVATION

Although many cities around the country are growing rapidly and evolving their transportation systems in response, many innovations can become a shock to those systems when implemented without sufficient preparation and proper guidance. As seen in numerous e-scooter deployments in recent years across multiple U.S. cities, momentum to deploy micromobility solutions can be lost when confronted with infrastructure, regulations, and policies that are unprepared to make these solutions operate safely and equitably. Many cities continue to play catch-up to new innovations because they are not adequately prepared for the array of challenges and opportunities that emerging mobility solutions will continue to bring at a rapid pace. Some of these advancements are outlined in the image on the following page.

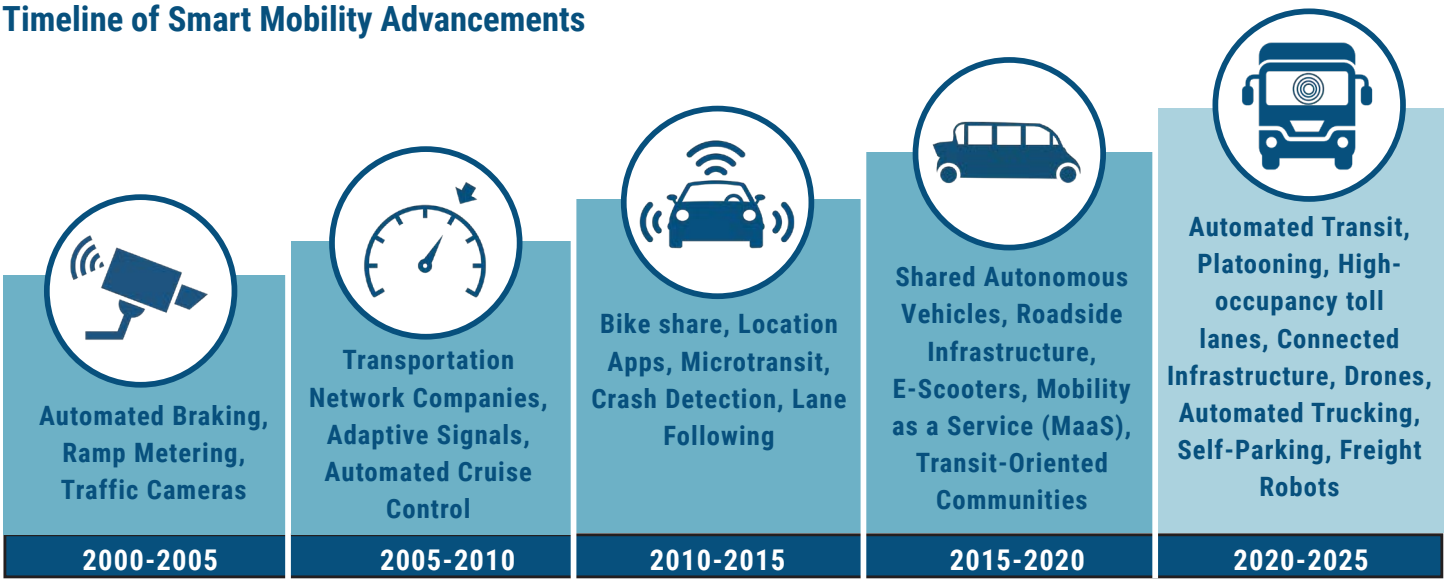
In contrast to many cities, Tulsa benefits from a foothold in several technologies that will inevitably become commonplace nationwide in the coming months and years. Tulsa already deploys advanced transit, micromobility, and electrification solutions. This is in part thanks to a constant push by public and private leaders who want to ensure Tulsans have access to transportation innovations and that these emerging markets can operate in Tulsa. As described below, Tulsa's partners in industry and academia regularly test new solutions and are motivated to build a mobility ecosystem across the region. By leveraging existing integrated innovations and preparing now for a gradual increase of potential offerings in the pipeline, Tulsa is already well-poised to become a leader in mobility innovation.

Here are some of the innovations on the ground in Tulsa today:

BUS RAPID TRANSIT (BRT)

Tulsa is one of just a handful of cities in the U.S. leading the charge to implement Bus Rapid Transit (BRT) service. BRT offers a cost-effective way of expanding transit use through enhancements in frequency, speed and reliability. These benefits are due to a combination of physical and operational improvements integrated permanently into key parts of the transit system.

Timeline of Smart Mobility Advancements



With the continual rise of smart technology, the familiarity with and diversity of its options will continue to expand

As part of the Connecting Progress Plan, the Aero BRT has been strategically implemented in Tulsa to serve the high-demand Peoria corridor and connect it into downtown. Originating at 54th Street North and terminating at 79th Street South, 29 stations connect workers, residents, and students across the City quickly. One in seven of the City's residents and one in five of its jobs are within a 10-minute walk of the corridor. This corridor now carries more passengers than any other transit route in the city. A second planned BRT corridor will be operational in 2022.

What is MaaS?

MaaS is the delivery of seamless, infinitely adaptable, on-demand mobility services through an integrated digital platform across **all available modes** of transportation.

Tulsa committed to BRT before many cities even knew of the technology. The Peoria corridor was the top transit priority in the 2009 Tulsa Comprehensive Plan, PlaniTulsa. Tulsa Transit worked diligently to develop a high-quality service by the Aero BRT launch in December of 2019. The bus runs every 30 minutes, increasing to a frequency of every 15 minutes during peak periods. Increased amenities were an essential part of incentivizing regular bus riders as well as those who typically drive to their destinations. Some of the amenities found at every station include sheltered seating, bicycle racks, level boarding platforms, and real-time arrival displays. Onboard, passengers also have free WiFi, charging stations, and next stop notifications.
Technology plays a significant role in the success of the Aero BRT by:

1. **Improving the rider experience** with passenger comforts and real-time data;
2. **Improving efficiency** of the transit network through coordinated signals that improve reliability of the route as well as general traffic; and
3. **Improving the value** of real-time mobility data, which enables Tulsa Transit to guarantee that the Aero BRT is meeting its goals and adjusting to Tulsa's needs as they evolve.

AERO BRT is connecting workers to areas downtown with a high concentration of jobs.

SHARED E-BIKE SYSTEM

The This Machine electric bike share system is helping to improve mobility with a door-to-door option that is affordable, and supports those who don't own a car or bike, want to make both short and long trips without a car, or simply want a healthier lifestyle. The fleet of over 200 electric-assist bikes located at 30 stations was launched in July 2020, serving downtown Tulsa and several surrounding neighborhoods. A variety of payment options accommodate pay-as-you-go trips, day passes, or monthly memberships, with discounts for many riders offered through local social service organizations.

This Machine is a leading national example of how to smartly plan for emerging forms of mobility and implement them without a disruption to existing systems. By working collaboratively with vendors and social service organizations, the City developed clear goals and rational system management rules that do not disturb normal city maintenance or enforcement regimes while supporting the quick launch of a completely new transportation option across Tulsa. This Machine has paved the way for additional micromobility and emerging shared mobility deployments in Tulsa with networks that are well-planned, equitably-deployed, and monitored with the ability to adjust as needs evolve.

E-SCOOTERS

In late 2018, Lime e-scooters began aggressively deploying in visible Tulsa downtown locations and near the Gathering Place on the east bank of the Arkansas River. Within the first few months, 40,000 people had taken over 150,000 rides. As this pattern continued, Bird also joined with even more e-scooters and, as a result, users across the city have integrated micromobility into their daily lives. Even during the COVID-19 pandemic, Tulsans continued to use e-scooters citywide.

E-scooters now play a big role in closing many mobility gaps between neighborhoods across Tulsa. As a result, the City responded quickly to develop regulations that accommodate this new form of mobility yet maximize safety and minimize negative impacts. Some of the responses include several app-enabled slow speed zones to mitigate existing conflicts with pedestrians and sidewalk retail, as well as no-parking zones where the City issues fines if devices are left to clutter the area. By dedicating a portion of e-scooter revenues to sidewalk improvements, and installing more bike lanes, these deployments are also a tool to improve City infrastructure, and encourage biking and walking.

ELECTRIC VEHICLE CHARGING NETWORK

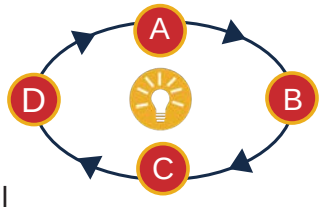
Oklahoma is a national leader in the deployment of an electric vehicle (EV) system through its extensive networks of charging stations installed along all major highways and throughout cities like Tulsa. Tulsans have access to regular and fast-charging stations throughout the city, especially at primary visitation destinations,

like museums, universities, shopping centers, and in downtown. New stations are regularly being added in response to the growing market for electric vehicles, which despite its relatively small market share, has been number one in EV sales growth for several years.

Tulsa leads the state in both its density and quality of electric infrastructure. This success derives from an early commitment to electrification, developing smart partnerships with providers and landowners, and assigning staff resources who are dedicated to making a critical mass of stations become permanent fixtures in Tulsa. Tulsa's electrification ecosystem is a prime example of how the City can lead the nation in smart mobility deployments.

The location and visibility of bike share stations are big factors in how likely they are to be utilized.

2.2 FOUR INNOVATION INITIATIVES



The Mobility Innovation Strategy outlines a course of action that responds to the needs of Tulsans and builds off the City's successes, strong partnerships, and a well-planned approach to innovation. The City hopes to build a long-lasting smart mobility ecosystem that improves equity and access for all Tulsans by directly addressing four primary objectives with four mobility initiatives.

1. MOBILITY INNOVATION AND EQUITY

Tulsa has a long history of racial inequities that have often been reinforced by its transportation infrastructure investments. Over time, entire neighborhoods have seen easy access to good paying jobs, quality food, health care, and education diminish, while other parts of the City, like North Tulsa, still face significantly longer and more costly trips to these essential resources than the average Tulsan. In recent years, the City has worked aggressively to overcome this inequity, and early mobility innovations have demonstrated that there are cost-effective solutions that can rectify many inequities.

Objective 1 — Provide Underserved People & Neighborhoods with Mobility Services that Connect to Jobs, Food, Health Care, and Educational Services

While many inequities find their roots in the Tulsa Race Massacre, a recent strategy document by the City recognizes that a culture of isolation evolved, and "historical actions including redlining and exclusionary zoning have led to disinvestment in neighborhoods that were once thriving in Tulsa."[1] A 2018 analysis of publicly available data under the Home Mortgage Disclosure Act found that black Tulsans were 2.4 times more likely to be denied home mortgage applications than white applicants in Tulsa.[2] Greenwood and North Tulsa remain some of the only affordable neighborhoods for some, yet transportation investments in these areas have lagged over the years. Most new road development and rehabilitation have focused on other Tulsa neighborhoods in response to patterns of wealth and residential development.

The City and Tulsa Transit have worked to dedicate new service to underserved neighborhoods, yet significant gaps remain that cannot be bridged with the amount of funding currently available for transit. However, recent transit innovations, last-mile mobility solutions, and shared mobility programs in Tulsa have demonstrated that inequities can be addressed cost-effectively within existing budgets or in partnership with mobility innovators in the private sector and academia. To help accelerate equitable mobility solutions, Tulsa needs to build upon this recent momentum and develop a lasting innovation ecosystem that embraces, designs, and deploys the mobility solutions of the future—for both Tulsans and Americans as a whole.

Local innovation can begin with Tulsa Transit, where an ongoing culture of efficient and responsive change can continue by improving service in key areas and along key corridors that connect people more equitably to jobs, food, healthcare, and education. Innovative solutions such as strategically placed mobility hubs offering last-mile connections into neighborhoods from bus stops can greatly expand the reach of transit. By working with micromobility, robotic delivery, and microtransit vendors, the City can develop policies that encourage these services to evolve quickly and provide infrastructure support where safe, non-auto connections are lacking.

1 Heath, D. (2020, May 29). The Case for Reparations in Tulsa, Oklahoma: A Human Rights Argument. Human Rights Watch . https://www.hrw.org/news/2020/05/29/case-reparations-tulsa-oklahoma.

2 Home Mortgage Disclosure Act HMDA data

2. MOBILITY INNOVATION POLICY

Innovation requires a rethinking of traditional transportation operations, regulation, and funding priorities, which have historically been focused almost exclusively on the private automobile. A healthy mobility ecosystem is one where multiple modes work together on a daily basis to satisfy a wide range of trip purposes and traveler types, with many non-auto modes being the most efficient method for thousands of potential trips every day. For Tulsa to move past its automobile-only history and give lasting support to emerging mobility innovations, new policies that promote modal choice will be needed. These policies need to provide a framework that aligns with Tulsa's mobility vision but also creates the path for adaptable and nimble advancement as mobility innovations and use cases continue to evolve.

Objective 2 Develop Lasting Governance and Funding Policies That Ensure Tulsa's Regulating Bodies and Codes Enable and Support the Development of a More Equitable and Multimodal Transportation System

Policy innovation begins with changes to any current or future regulations that may restrict the safe and equitable deployment of AVs, microtransit, micromobility, and their supporting physical and digital infrastructure and platforms. These smart mobility solutions have all been demonstrated to be advantageous for meeting community needs since they are flexible, affordable, accessible, and help reduce congestion, while being energy efficient. However, supporting policies are needed to drive regulatory change while ensuring that mobility innovation benefits all citizens, even those that may be unbanked, lack internet access, or do not have a reliable wireless connection for their mobile phones. The challenge is that regulations take time to catch up with technology, and there is a danger of creating overly prescriptive rules as the technology is still being developed and use cases are coming into focus. As an example, the deployment of dockless e-scooters in communities across the country demonstrates both the opportunities and flexibility needed from a regulatory perspective. Many deployments were initially viewed negatively because communities did not have plans ready in time. Innovations like these, along with investments in bike and pedestrian infrastructure, present tremendous opportunities from a first- and last-mile connectivity standpoint. However, in nearly every case, the initial approach to deploying e-scooters has been altered to correct safety, access, and equity issues. The successful deployment of such emerging mobility innovations requires advanced planning and adaptability. As such, regulations must also be flexible and adaptable, which requires the development and broad support of smart citywide mobility policies to ensure that mobility innovation meets broader community and equity goals.

As current laws and ordinances continue to be tested, the City should develop a smart mobility focused policy framework that:

- Addresses **safety, access, and equity citywide** during the deployment and evolution of new mobility solutions, particularly those incorporating new technologies like automated and demand responsive platforms
- Offers opportunities to coordinate with state legislative priorities to **broaden support and streamline funding and implementation** of pilots and deployments
- Aligns with Tulsa's **demonstrated transportation needs** and the desires of all constituents
- **Dedicates resources** to support pilot projects, changes to data regulations, and ongoing monitoring and evaluation of mobility programs and solutions

3. MOBILITY INNOVATION ECONOMY

While many regions across the country are working quickly to integrate new mobility technologies into their transportation systems, Tulsa is uniquely positioned to also make the development of these emerging technologies a part of the local economy. Smart mobility solutions have the ability to address many needs in Tulsa equitably, but that opportunity can easily broaden beyond simply benefiting from innovations to charting the course for invention by building a local mobility innovation economy.

Objective 3 Build out the Mobility Innovation Economic Systems by Building Local Talent, Improving Access to Jobs and Education, and Attracting Jobs

Tulsa's economy is already strong in energy and aerospace, with talented technology employees and skilled training available locally. While most parts of the United States lack the workforce experience to easily develop a mobility innovation economy, many Tulsans have skills that are transferable to those needed to deliver emerging transportation technologies, especially around engineering and manufacturing instrumentation experience. These existing economic strengths can enable Tulsa to be a research, testing, manufacturing, and deployment center for multiple emerging transportation solutions: for instance, building upon local skills to lead the development of the manufacturing process for the instruments, advanced motors, and search and navigation instruments that enable many smart mobility devices.

Development of a mobility innovation economy has the potential to equitably serve Tulsans working both in and outside of this new economy by having new mobility pilots tested and permanently deployed on Tulsa's transportation networks. Creating a mobility ecosystem that attracts and retains top talent will also benefit those not working in the industry. Already, the local organizations testing and deploying micromobility, transit, drone, and other emerging solutions are creating a buzz and attracting new ideas and fresh planning focus on the future. Rapidly building a mobility innovation economy is achievable in Tulsa, especially by working in collaboration with these existing local partners.

Manufacturing facilities like this throughout Tulsa provide products and support to many industries.

4. MOBILITY INNOVATION PARTNERSHIPS

Central to moving Tulsa forward in mobility innovation is building strong public and private partnerships of support and action. Only with a committed and sufficiently comprehensive set of partners can any region expect broad-based and equitable success. Tulsa already has key foundational partners interested in building a mobility ecosystem, and several valuable champions have already proven to be effective at getting things done. Now is the time to formalize existing relationships and build momentum that brings others into the fold.

Objective 4 Create Substantial and Lasting Public and Private Partnerships That Facilitate an Equitable Mobility Innovation Ecosystem

Essential partners can provide the expertise, resources, and physical places needed to design, prove, scale, and integrate the variety of digital, vehicle, and fueling technologies of smart mobility solutions. The breadth of smart mobility technologies demands expertise and use cases from a range of disciplines and places. Partnerships among the business community, investors, technology nonprofits, philanthropic organizations, and universities are needed, with each acting as a developer, convener, first customer, or valuable leader in identifying financial and in-kind support.

The most important partners will be the users who benefit from smart mobility solutions. Community members, residential communities, employers, medical centers, grocery stores, university affiliates, freight operators, shippers and receivers, restaurants, entertainment venues, and many more partners will be the proving grounds and benefactors providing essential input and feedback. Tulsans living and working in downtown, residential neighborhoods, Osage Nation lands, Muskogee Nation lands, Cherokee Nation lands, the international airport, Tulsa's inland river port, and multiple local universities will be brought into the mobility ecosystem and become the cutting edge for solution refinement.

Hillcrest Medical Center is an anchor institution in Midtown Tulsa.

2.3 KEY STRATEGIES

An array of strategies to advance mobility solutions within each of the four initiatives are described in detail in the following chapters. These are summarized below. Detailed timelines, early actions, and responsible parties are identified in Section 8.

EQUITY

A1. Implement East-West **BRT service**

A2. Build out **GoPass payment** fully

A3. Expand Mobility As A Service **(MaaS)**

A4. Deploy **microtransit**

A5. Expand **shared mobility** and micromobility

A6. **Mobility hubs** at transit hubs with EV shuttle and micromobility connections

A7. Align bus service and **grocery store hubs**

A8. Enable electric vehicle (EV) **shuttle connections**

A9. **Expand micromobility**

A10. Initiate **automated delivery pilots**

A11. Change **funding priorities**

A12. Implement tools for **increased walk safety**

A13. Expand bicycle and micromobility **infrastructure**

POLICY

A14. Transportation Demand **Management**

A15. Transit **Benefits/ Subsidies** applied across modes

A16. Investment **strategy** prioritizing transit, bicycle and pedestrians

A17. **Land use**

A18. **Curb management**

B1. Update the **building code** to include access and parking for shared mobility

B2. Refine **parking requirements** to incentivize walkable mixed-use development

B3. Create new **zoning policies** that incentivize denser mixed-use development

B4. Update Tulsa's **Comprehensive Plan** to chart transit-oriented mobility nodes and corridors

B5. Design a **data collaborative**

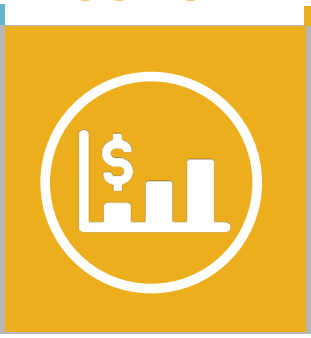
B6. Develop a citywide data governance **framework**

B7. Pilot data **revenue opportunities**

B8. Establish City/ INCOG **task force** to plan, fund, and evaluate AV pilots

B9. Modernize city **procurement process**	**B10.** Create program of pilots to bring **innovation to scale**	**B11.** Develop a public-private **funding plan** collaboratively	**B12.** Support the state pilot **innovation fund**	**B13.** Secure local / regional **P-3 authorization**	**B14.** Invest in **safe places** to walk, bike, and scooter	**B15.** Initiate regular **community engagement** on shared mobility

ECONOMY

B16. Expand and connect walking and micromobility **networks**	**B17.** Integrate **pedestrian safety** in downtown mobility programming	**B18.** Expand **access** to micromobility		**C1. Foster micromobility**	**C2.** Create **safe spaces** to walk/bike	**C3.** Provide **mobility services** to colleges

PARTNERSHIPS

C4. Partner with universities and colleges to build out technical **skills program**	**C5.** Fill gaps in local **supply chain** components for key industries	**C6.** Create mobility **innovation centers** on cybersecurity, AV freight, and logistics	**C7.** Develop a **cyber district**	**C8.** Create **multimodal test beds** for AV freight, port, and aerial systems		**D1.** Pioneer **digital assessments** of the street, curbside, and sidewalks

D2. Alleviate curbside congestion with **smart zones**	**D3.** Pilot micromobility hubs with electric **charging capabilities**	**D4.** Join with Tulsa Transit, campus transportation, and venues in piloting an **AV shuttle pilot**	**D5.** Pilot first and last-mile **freight delivery**	**D6.** Create **partnership network** to convert campuses and corridors	

3. INITIATIVE A: INNOVATION AND EQUITY

Expand shared mobility to people living in underserved areas

INITIATIVE A: MOBILITY INNOVATION AND EQUITY

OVERVIEW

The City's top priority is achieving community resiliency and equity for *all* Tulsans. As noted in *Resilient Tulsa,* the City has been "shaped by its complicated history of racial tension." Tulsa seeks to build a better community by confronting its historic discrimination and inequality.[1] Equitable access to transit and other forms of shared mobility is central to achieving goals in equity as well as economic development and environmental sustainability. The City's currently limited transportation options make it difficult for many to reach work, school, health care, and even a grocery store. People must either take on the financial burden of owning a vehicle (which accounts for 20 percent of the annual household median income in Tulsa[10]) and even more for those in poverty), rely on long transit trips with poor first- and last-mile connections, or walk or cycle along roads that often lack safe accommodation for pedestrians. Instituting innovative mobility solutions and expanding shared mobility options that address these challenges will ensure that all Tulsans have affordable and efficient access to not only essential daily destinations, but also to the entertainment, social, and cultural opportunities that enhance quality of life for all.

Tulsans' quality of life will improve through equitable access to places such as grocery stores, healthcare facilities, educational resources, and job centers. By embracing more efficient and shared options beyond the private automobile, reduced congestion will also benefit greater Tulsa's environment while the city's economy will thrive as a result of connecting talent to new jobs.

1 City of Tulsa, 100 Resilient Cities. (2018). Resilient Tulsa. (p.10) Retrieved from https://www.cityoftulsa.org/media/7673/reslient-tulsa-digital-web.pdf

10 U.S. Census Data

3.1 EXPAND THE REACH OF TULSA TRANSIT

CHALLENGES AND OPPORTUNITIES

The success of Tulsa Transit is the foundational element of the citywide Mobility Innovation Strategy. The advent of automated vehicles (AVs) and new mobility technologies do not change the fact that transit remains the most efficient way to move large numbers of people, and no visionary plan can be effective without continued focus on funding and growing Tulsa Transit. However, the Authority currently faces several limitations that make it inconvenient for some to use transit:

- Long headways
- Poor first- and last-mile connectivity
- Bus stop amenities and support infrastructure is lacking
- Untimely, non-emergency medical transportation

Tulsa Transit is actively extending service, improving payment options, and planning to improve traveler infomation. The Peoria Avenue BRT line runs North to South, connecting Tulsans to downtown jobs with 15-minute headways. The new BRT line in 2022 will fill in the gaps for key East-West connections. Tulsa Transit is negotiating with Lyft for a smartphone-enabled first- and last-mile service that will be piloted at a BRT station and connect riders to shopping, health, and cultural destinations that are beyond a short walk. Tulsa Transit is also proceeding with business and operational planning for microtransit nighttime service in Broken Arrow. Meanwhile, payment innovations—such as a new partnership with QuikTrip to purchase bus passes—are making it easier to use transit services in Tulsa.

BENEFITS

- **Improve quality of life**
- **Expand opportunities through access to employment, education, and healthcare**
- **Reduce congestion**
- **Support current investments in Tulsa Transit**

PARTNERS

- **Tulsa Transit**
- **This Machine**
- **Uber, Lyft**
- **City of Tulsa**

SAMPLE METRICS

- **Increase in number of low-income, low-vehicle ownership census tracts with access to transit, micromobility, and bike share**
- **Number of Tulsans within a 10-minute walk of transit and/or bike share**
- **Number of subsidized rideshare trips by bus stop**

FUNDING

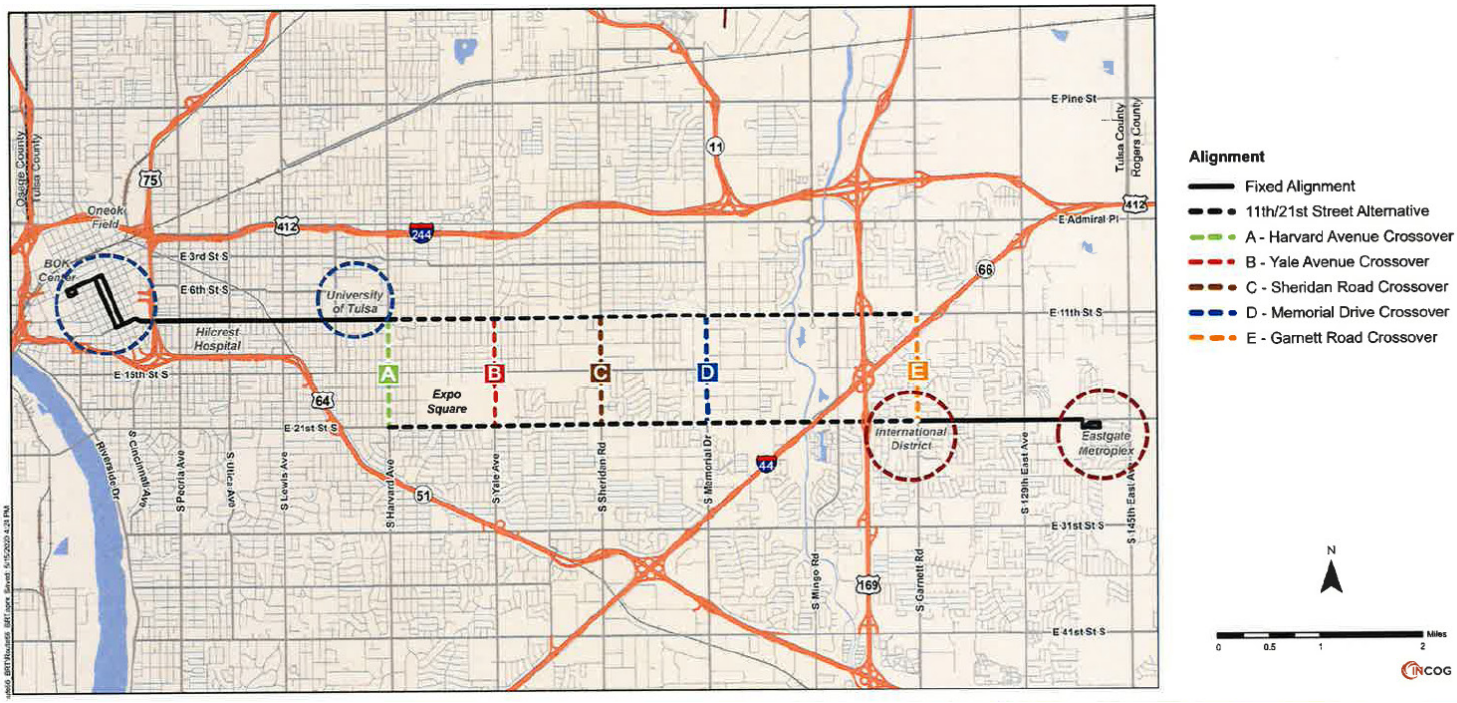
- **FTA competitive grants**
- **American Rescue Plan Act (ARPA)**
- **Coronavirus Aid, Relief, and Economic Security Act (CARES)**
- **Department of Energy**

Tulsa Transit has an opportunity to increase ridership by increasing frequency and reliability for current transit routes, enhancing first- and last-mile connections to destinations, and expanding coverage of shared mobility to areas and time periods not currently served by transit. The following strategies build upon Tulsa Transit's recent successes and ongoing technology upgrades.

A1. IMPLEMENT EAST-WEST BRT SERVICE

Following the success of the Peoria Avenue Bus Rapid Transit (BRT) project, Tulsa Transit will open another Aero line in 2022 along the Route 66 corridor. This route will connect the University of Tulsa with downtown at 15-minute headways. The City could complete this as a BRT route with off-vehicle ticketing, transit-oriented design, placemaking strategies, first- and last-mile connections, and densification to encourage non-vehicular modes of travel.

Planned Route for Tulsa's Route 66 BRT Line

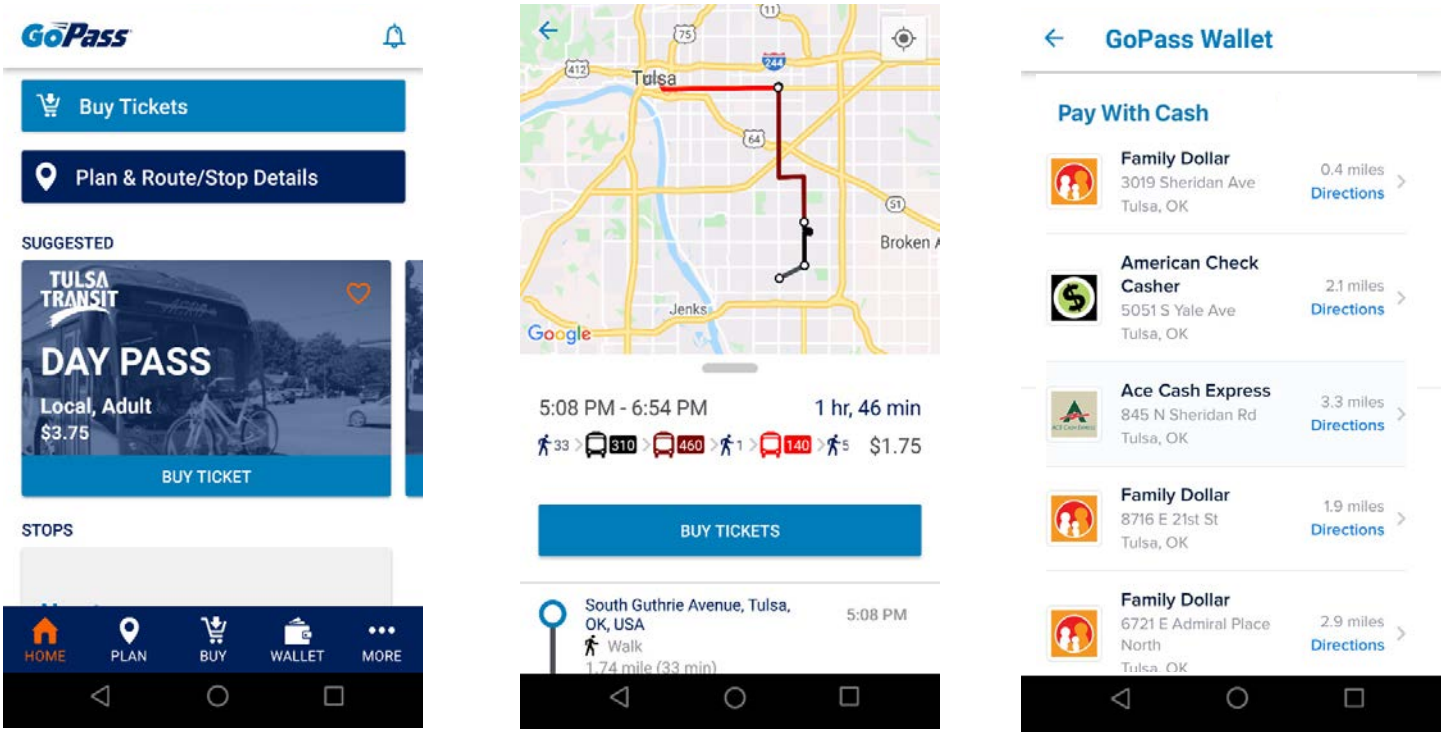


Source: INCOG, October 2020

A2. BUILD OUT GOPASS PAYMENT FULLY

Tap fare payment options and point-of-sale features allow businesses and social service agencies to manage employer and client passes with ease. Currently, people without smart phones or bank accounts can use PayNearMe payment kiosks located at QuikTrip convenience stores. More locations may be warranted. In addition, Tulsa Transit may also look to web-based booking and payment with the ability to print paper QR codes as another way to address equitable access.

Existing GoPass Mobile App



Tulsa Transit's GoPass allows off-bus fare payment and pass purchases, simplifying and expanding access.

A3. EXPAND MOBILITY AS A SERVICE (MaaS)

Integrating payment, travel planning, and multimodal choices will make it easier for people to travel around the region. Expanding MaaS through GoPass offers many benefits; it gives travelers a way to plan, book, and pay for a trip using one or multiple modes. With this tool, residents and visitors will be able to get to work, school, and healthcare as well as enjoy entertainment, recreation, and retail opportunities. MaaS should generate new revenues for the city, increase use of transit, shuttles, and bikes, and introduce new efficiencies in operations. Accessibility for people with a disability could be provided through haptics and voice-activated features. Success depends on expanding transportation services and including them on the GoPass. Tulsa Transit's pipeline for the app includes shared bikes and e-bikes, shared rides, microtransit service, and paratransit. Additional services could include non-emergency medical transportation, car sharing, parking, and airport transportation.

A4. DEPLOY MICROTRANSIT

Microtransit, or Mobility on Demand (MoD), can provide extended shared mobility in areas such as North Tulsa, where people may not live near transit stops, and in low density areas. Employers, social service agencies, and nonprofits may be willing to sponsor first- and last-mile shuttles to high-capacity transit, employment centers, and health care facilities. Tulsa might contract with private providers for dispatch or management of its fleet for mobility on demand service. Employing on-demand microtransit in place of infrequent or low-ridership routes can expand service, improve reliability, and save Tulsa Transit money, especially if applied to non-emergency medical transportation and paratransit.

CASE STUDY- **FCC Lifeline Program**

Source: FCC

The Federal Communications Commission's (FCC) Lifeline Program provides low-income participants with discounted phone service and broadband, increasing their access to info and services.

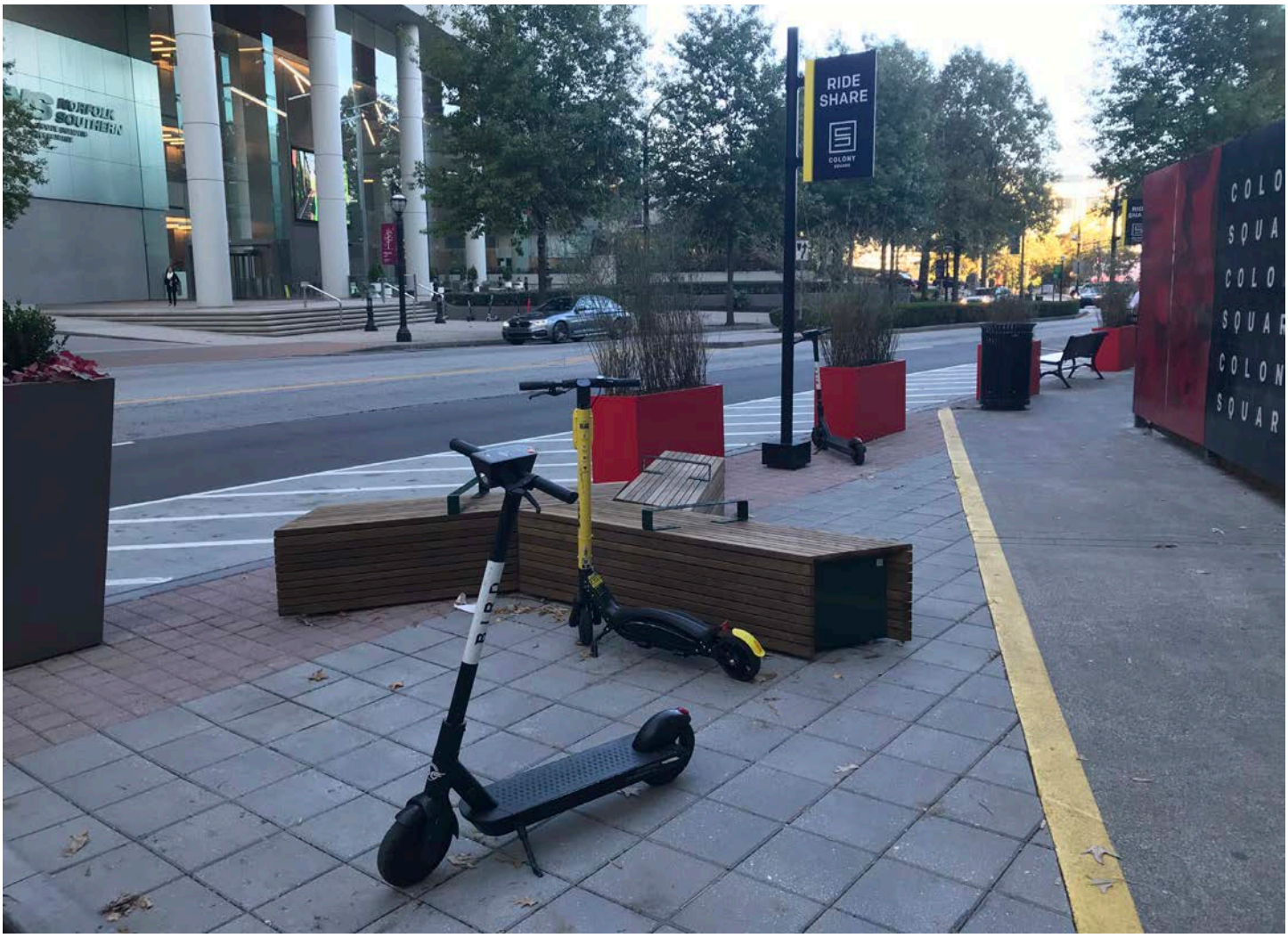
CASE STUDY- Bakersfield, CA First- and Last-Mile Micro Transit

Source: City of Bakersfield

In Bakersfield, California, GETbus replaced several low density and low ridership routes with on-demand door to door service. Combining paratransit service promoted universal inclusivity and saved the transit agency money.

A5. EXPAND SHARED MOBILITY AND MICROMOBILITY

Shared rides, shared vehicles, and micromobility each offer other ways to expand access to economic, health, education, and recreational opportunities. This Machine bike share and shared e-scooters could be further encouraged to expand their footprints to ensure that they reach priority areas, such as North Tulsa or neighborhoods with low vehicle ownership. The City currently requires all shared vehicle operators to place at least 20 percent of their vehicles in an underserved community, as determined by City staff; this can be enforced and the percentage increased. Enhanced devices that allow families to use shared mobility can also be deployed, such as multi-seat cargo e-bikes. Equitable service can be further achieved through cash options and continued partnerships between This Machine and social service organizations. Another example to consider is Gig Car, which offers a public franchise car share model that extends electric vehicle car share to areas underserved by transit. In addition, it has been found that e-bikes can extend a service area by up to ten miles. Pilots in Detroit and Chicago provide models for providing shared mobility to essential workers and to small businesses in low-income communities. These recommendations merge with land use, design guidelines, and parking requirements that can be modified, especially for new downtown construction, to incentivize shared mobility options.



E-scooters are heavily deployed in downtown Atlanta, Georgia.

A6. MOBILITY HUBS AT TRANSIT HUBS WITH CONNECTIONS FOR EV SHUTTLES AND MICROMOBILITY

Providing more affordable and reliable access to multiple mobility options in a single location would provide Tulsans with greater connectivity to jobs and other key destinations. Multimodal mobility hubs including This Machine bikes, e-scooter docks, and carshare pods at existing transit Hub and SubHub locations would provide charging infrastructure, e-commerce delivery, and travel information. These mobility hubs could be colocated with retail, including parklets and plazas with outdoor furniture to create a stronger sense of place. At a minimum, these mobility hubs should incorporate charging infrastructure, payment kiosks, and wayfinding. Micromobility hubs may also be appropriate at other key transfer points in downtown and at BRT stations. Providing free parking options next to these hubs could also encourage car users to use public transit for part of their journeys.

CASE STUDY- North Boulder Transit Hub Feasibility Study

The City of Boulder partnered with Boulder County, CDOT, and RTD to develop a multimodal transit center concept that could act as a gateway into the city.

On-site transportation services are proposed to include a transit station and bus turnaround, bike share (B-cycle) station, Bike-n-Ride shelter, and car share services. Architectural and sculptural placemaking elements will contribute to the high-quality experience of the hub.

Source: Leese & Associates

AS1. Pursue Public-Private Partnerships

Tulsa should forge partnerships with TNC operators to make first- and last-mile connections between transit and large employers and other popular destinations. Tulsa Transit should explore partnerships with employers for connecting rides with Lyft from BRT to employment centers.

AS2. Initiate a Pilot for Mobility on Demand/Microtransit for Night-Time Service

Initial steps include developing a business plan for service of essential workers and others traveling off-peak in low density areas and developing a funding plan including FTA and DOE grants, in- kind contributions from tech providers, employer subsidies, and CARES Act funding, among other options.

AS3. Create an Action Plan to Address Service Gaps

Drawing on recent transit propensity and operations analyses, develop a 12-month plan to address service gaps in neighborhoods with lower vehicle ownership and higher employment rates. Focus on the areas bounded by North Harvard Avenue, North Yale, East Admiral and East Apache. Consider collaborative efforts to support development or expansion of a local mobility provider based in North Tulsa.

AS4. Partner with Community Organizations

Develop travel training and outreach programs for multimodal mobility options with community partners. Components should include familiarization with shared rides and shared vehicle services, shared e-bikes and scooters, and BRT services. Outreach should focus on incentives to use the Tulsa Transit Go Pass, expand cash payment locations, and offer subsidies. Travel training in the community would be supported by multilingual video and print material.

Source: City of Fort Lauderdale

Highly visible Pick-Up/Drop-Off zones like these in Fort Lauderdale increase the efficiency of the curb.

3.2 IMPROVE ACCESS TO HEALTHY FOOD: GROCERY STORE MOBILITY HUBS

CHALLENGES AND OPPORTUNITIES

Tulsans throughout the City—and in North Tulsa in particular—lack convenient access to healthy food options. Spatial analysis reveals that low-income neighborhoods with low car ownership correspond to those that lack supermarkets. Challenges to healthy food access in Tulsa include the following:

- In neighborhoods such as Lakeview Heights and River West, supermarkets are beyond a reasonable 10-15-minute walking distance.
- Infrequent transit services and poor first- and last-mile connections are barriers for people without cars.
- Lack of access is exacerbated by the City's low population density, as supermarkets are not located near where many Tulsans live.
- Tulsa's CAN Plan study found that 55 percent of North Tulsa survey respondents have difficulty buying food either "always" or "most of the time."
- Focus groups identified preference of residents in food deserts to travel to grocery stores rather than have prepared food delivered to them.

A number of initiatives are underway to increase access to healthy foods, primarily by bringing groceries or grocery stores to underserved areas. This Machine has a grocery delivery partnership with INCOG to deliver healthy groceries to seniors and people with disabilities under the AARP grant Grocery Delivery Pilot Program. As a result of the Creating Access to Nutrition (CAN) Plan findings, Tulsa Transit piloted an experimental shopper service in Bixby, while a public-private partnership pilot in North Tulsa will help seniors and people with disabilities get to supermarkets. The Resilient Tulsa Plan's Healthy Places Initiative seeks to address issues such as food access in high-needs neighborhoods, starting with River West and Comanche Park. Tulsa recently secured a big victory with the recent opening of Oasis Fresh Market in North Tulsa. This facility now addresses a significant food desert that had been identified as an issue for over 10 years.[1] Tulsa Transit has also provided free service to Saturday farmers markets on a provisional basis. In addition, INCOG is exploring innovative, technology based solutions for increasing transportation choices in neighborhoods with low car ownership and low transit access.

BENEFITS

- **Improve access to supermarkets for Tulsans without vehicles**
- **Improve Tulsans' health**
- **Increase Tulsa Transit ridership**
- **Serve resilience needs as a drop-off/pick-up point for essential supplies**

PARTNERS

- **Grocery store owners**
- **Tulsa Transit**
- **This Machine**
- **Uber, Lyft**
- **Tulsa Health Department**
- **Tulsa Authority for Economic Opportunity (TAEO)**

SAMPLE METRICS

- **Increase in number of households in below-median income census tracts with convenient fresh food access**

FUNDING

- **City of Tulsa**
- **Private partnerships**
- **Emerging mobility vendors**
- **Department of Energy**
- **Department of Transportation**
- **FTA grants**

1 Pizarro, S. (2021, May 17). Oasis Fresh Market opens in north Tulsa after 10-year food desert. *2 News Oklahoma*. https://www.kjrh.com/news/local-news/oasis-is-north-tulsas-hopeful-savior-from-a-10-year-food-desert

INNOVATIVE HEALTHY FOOD STRATEGIES

Creation of designated grocery store mobility hubs would connect people across neighborhoods to food by providing transportation options to grocery stores for people of all ages, income levels and abilities. The resiliency hub integrates shared mobility for people traveling to stores, as well as home delivery options. This can correct the spatial mismatch between neighborhoods where grocery stores have traditionally been out of reach due to lack of convenient, safe and affordable travel options. The mobility hubs can also serve resilience needs as drop-off and pick-up points for essential supplies during emergencies, such as following severe weather events or during the COVID-19 pandemic, as well as provide convenient delivery for e-commerce.

The City could designate grocery store mobility hubs with transportation options for people of all ages and abilities. This would be a first of its kind approach to food security and a system of mobility hubs. Additionally, transit-oriented development planning could seek new grocery stores aligned with transit, and social and health services could be recruited to serve grocery store hubs both with pop-up and permanent locations.

A7. ALIGN BUS SERVICE AND GROCERY STORE HUBS

Grocery stores with existing bus service make good candidates for these hubs, especially when augmented by additional service. This might be achieved by reallocating Tulsa Transit buses based on ridership. Some buses have low ridership only at certain times of the day, particularly at night. Focusing the analysis results from Tulsa Transit's route optimization study could provide opportunities to improve service on low performing routes with mobility on demand or even AV service. Buses could then be reassigned to increase service on busier routes. Bloomington Transit (Indiana) incorporated these alternatives in their route optimization study, resulting in innovative solutions that allowed their system to adapt to changing needs and technologies over time.

Tulsa's Oasis Fresh Market opened in May 2021 after a years-long effort to enhance access to healthy food in North Tulsa.

A8. ENABLE ELECTRIC VEHICLE (EV) SHUTTLE CONNECTIONS

Mobility hubs will serve as connection points for EV shuttles or microtransit routes connecting to Tulsa Transit routes. An enhanced Tulsa Transit shelter will create a welcoming atmosphere for patrons waiting to transfer between transit and shuttle routes. Electric charging infrastructure for shuttles, buses, and even private EVs could be incorporated.

A9. EXPAND MICROMOBILITY

Available micromobility options at a grocery hub should include This Machine shared e-bicycles and multi-seat cargo bikes, plus shared e-scooters with charging docks. These and other electric mobility devices could provide additional convenience and ease, especially for visitors transporting groceries. Currently, bike share stations are located at Reasor's on 15th, across from Trader Joes, and are planned near other grocery stores south on Peoria to 41st and 45th. This Machine currently advertises inside BRT buses to promote using bike share as a first- and last-mile option.

Micromobility options should be integrated into a MaaS system to facilitate seamless connections across modes. Those without smartphones could access micromobility services via a shared mobility kiosk at docks and hubs.

A10. INITIATE AUTOMATED DELIVERY PILOTS

Autonomous delivery should be made available to ensure access to groceries by those who may not be able to leave their homes. Delivery services will also ensure resiliency during a pandemic or other event by facilitating transport of essential supplies.

A Nuro automated delivery vehicle can operate from grocer to home on-demand.

CASE STUDY- Minneapolis, MN Mobility Hub

Source: Shared Use Mobility Center

In 2019, the City of Minneapolis initiated a mobility hub pilot to increase access to affordable, convenient, low-carbon transportation options. Mobility hubs offer amenities like parking and signage for people using transit, shared scooters, and shared bicycles. Over 800,000 trips were made at the 12 hubs during the yearlong pilot, and valuable lessons were learned to increase use and spread awareness of mobility options.

THE PRACTITIONER CHECKLIST

The Practitioner Checklist (Section 7) is a detailed resource outlining implementation of mobility hubs, including grocery store mobility hubs. The checklist provides an overview of the necessary mobility elements, partners, and operational considerations, including potential funding sources. It also includes sample metrics to measure effectiveness, as well as case studies from other U.S. cities.

SHORT-TERM ACTIONS

AS5. Designate Preferred Locations
Good candidates for grocery store mobility hubs will be in neighborhoods with below-median income, in a recognized food desert, and potentially within close proximity to 30-minute headway bus service. Initial candidates include the Oasis Fresh Market, Supermercados Morelos on North Harvard Avenue, or the Walmart Super Center on South Memorial Drive.

AS6. Initiate a Pilot Project
An initial pilot project can incorporate temporary elements such as painted crosswalks, jersey barriers, and signage.

AS7. Fund Tulsa Transit to Fill System Gaps
As an initial step, priority should be given to fill the transit service gaps at North Harvard Avenue and North Yale Avenue between East Admiral Place and East Apache Street, potentially with new micro-transit service.

AS8. Partner with Rideshare Providers
The City should work with rideshare providers (Uber and Lyft) to develop a subsidized program for access to grocery stores.

AS9. Install Lockers for Essential Mobility Supplies
Install lockers at grocery stores where visitors can securely pick up essential supplies like rain ponchos or spare bike tubes to help make commuting and other trips more comfortable and convenient. This could be done through a partnership with large online retailers, such as Amazon.

3.3 REMOVE WALK, BIKE AND MICROMOBILITY BARRIERS

CHALLENGES AND OPPORTUNITIES

Mobility in Tulsa is currently dominated by single occupancy vehicles; in 2020 it ranked 106 out of 141 U.S. cities with a population of 200,000 or greater in terms of walkability, and 102 out of 141 for bikeability.[1] Dissatisfaction with walking and cycling options were among the online survey respondents' top three mobility qualms. Few people choose to walk and bike around Tulsa because of limited dedicated facilities. Analyses show that downtown Tulsa has a relatively high sidewalk density. However, these amenities are often located in areas with low residential population density, while higher-density neighborhoods in North and South Tulsa have inadequate infrastructure. These barriers to walking, cycling, and micromobility force people to drive for trips that could otherwise be taken using other modes. This also forces Tulsans who depend on bikes as a primary mode of travel to ride in unsafe conditions.

The City has been working to reduce these barriers, including implementing recommendations from Walk Friendly Communities(1) to achieve national recognition. One-way streets in downtown are being converted to two-way streets as part of a road diet that includes repurposing vehicular travel lanes for wider sidewalks and protected bike lanes. Throughout 2020, Tulsa invested $1.5 million to add more than 50 miles of bike lanes, which could give 30,000 Tulsans without a car the ability to ride safely across the City. Tulsa's GO Plan outlines a strategy to improve walking and biking conditions. The GO Plan also highlights areas with low vehicle ownership, below-median-income populations, and missing connections to key destinations- such as schools and transit stops- as priorities for investments in walk and bike infrastructure. Since 2015, new sidewalks (65 miles) and bicycle infrastructure (66 miles) have been implemented as part of this plan's targeted improvements.

Partner organizations have also been working to increase access to safe cycling. Tulsa's Bike Club partners with local schools to train youth on safe cycling techniques. This Machine recently converted its bike share fleet to e-bikes through a partnership with e-commerce firm Drop to encourage longer rides and better distribution in at-need neighborhoods.

The City has an opportunity to build off this current momentum to expand its bicycle network and increase safety for pedestrians and micromobility users throughout the City.

BENEFITS

- **Increase equity**
- **Improve public health**
- **Expand safe mobility options**
- **Decrease congestion**
- **Reduce emissions from vehicles**

PARTNERS

- **Tulsa Transit**
- **Tulsa Housing Authority**
- **City of Tulsa**

SAMPLE METRICS

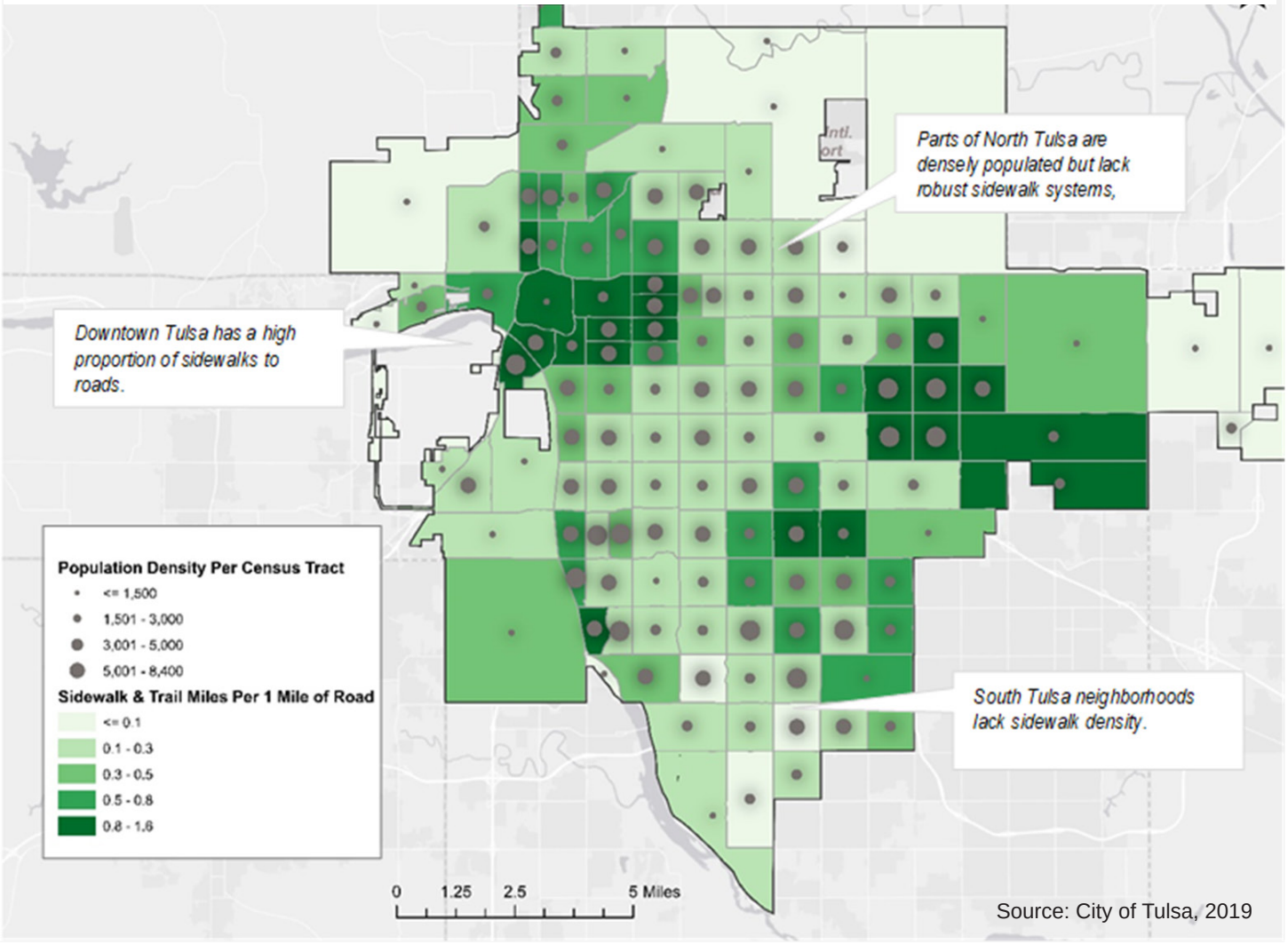
- **Reduction in VMT compared to baseline**
- **Reduction in CO_2 emissions**
- **Reduction in severe crashes involving people on foot, e-scooters, and bicycles**
- **Increase in ADA accessible/ audible crossings**

FUNDING

- **Transportation Alternatives Program**
- **Congestion Mitigation and Air Quality**

1 Walkscore, https://www.walkscore.com/cities-and-neighborhoods/

Sidewalk Density & Where Tulsans Live



Some higher density neighborhoods do not have correspondingly dense sidewalk network.

The City of Tulsa has constructed improved pedestrian crossings outside of The Gathering Place.

INNOVATIVE ACTIVE TRANSPORTATION STRATEGIES

Making it easier and safer to travel without a car in Tulsa will require a long-term focus on infrastructure that has been historically overlooked. Innovative delivery approaches can speed remedies. A program of strategies to remove walking, cycling, and micromobility barriers in Tulsa includes the following components. These strategies expand transportation choice for Tulsans, including families, in need of affordable, active, and flexible mobility options.

A11. CHANGE FUNDING PRIORITIES

The City should seek varied funding sources to fund bicycle and pedestrian infrastructure. The League of American Bicyclists provides a guide for funding such infrastructure projects. Existing Federal roadway funding sources, such as Congestion Mitigation and Air Quality (CMAQ) and Highway Safety Improvement Program (HSIP), can be re-prioritized for bicycle and pedestrian projects. Other sources of funding include local and regional sources, such as business improvement district funds and tax increment financing, as well as private sources, such as micromobility operators and large land developers.

A12. IMPLEMENT TRAFFIC TECHNOLOGY FOR INCREASED PEDESTRIAN SAFETY

The City should demonstrate the importance of walkability and safety through advancement of walk infrastructure and promotion of new safety technologies. Inventorying and replacing signage and utility poles located in the middle of sidewalks would make these paths safer for walkers, bikers, and wheelchairs. Traffic signal and control solutions to enhance safety include integrating walk signals into signal phases at busy intersections, and other components such as leading pedestrian intervals, radar-activated portable speed advisory signs, overhead pedestrian-activated lighting systems, and automated pedestrian detection. The City should also ensure that all crossings are ADA-compliant. The City should start by prioritizing schools, mobility hubs, and at-need neighborhoods identified in the GO Plan, including Osage Trail and Peoria Avenue.

A13. EXPAND BICYCLE AND MICROMOBILITY INFRASTRUCTURE

The City should seek to expand the bicycle network to better connect neighborhoods to the Osage Trail and the greater 918 Trail Network, downtown, the BRT corridor, and other transit routes and proposed mobility hubs. Enhanced safety for bicyclists and micromobility users can be achieved by creating dedicated space on select roads. These include South Cincinnati Avenue and Cheyenne Avenue between West Fairview Street and West 14th Street. In addition to expanding infrastructure, micromobility providers should also expand bicycle and e-scooter fleets to ensure that they are available to residents of underserved neighborhoods, such as those in North Tulsa. Adaptive options and cargo bicycles should be included to ensure equitable access. Cargo bikes allow riders to safely carry groceries, children, or other items many need to transport on a daily basis, making them a viable transportation choice for parents or caregivers in need of affordable, flexible mobility options. The Bike Friendly Community Report Card (League of American Bicyclists) from 2017 could be a good way to track key metrics for improving bicycle/micromobility infrastructure.

REPRIORITIZING FEDERAL FUNDS

Memphis, TN prioritizes cycling infrastructure in its funding criteria for project selection. Its Surface Transportation Program criteria process awards points for projects that include a “cycle track or shared-use path.”

CASE STUDY- Centennial & Lone Tree, CO Technology-Based Walking Improvements

Several Denver-metro cities partnered with private sector companies to install multimodal volume sensors along key roadways. Transportation agencies will leverage the real-time data collected by these sensors to make signal timing decisions that will improve travel times, safety, and efficiency for all modes traveling through the corridor.

SHORT-TERM ACTIONS

AS10. Pilot Protected Bike Lanes

Temporary solutions can be used to protect cyclists and micromobility users on key corridors. Pilot locations could include East 6th Street and MLK Jr. Boulevard.

AS11. Continue Walkability Projects

The City should continue improvements to meet Walk Friendly Community requirements. Specific initiatives include converting one-way streets to two-way, upgrading signals, and installing warning devices at pedestrian crossings.

AS12. Decriminalize Jaywalking

Decriminalizing jaywalking demonstrates that Tulsa's roads are open to all modes of travel and improve equity for Tulsans while pedestrian infrastructure improvements are underway. Federal research has found that pedestrian crashes occur with no fewer frequency in crosswalks vs. mid-block locations where jaywalking usually occurs.[1]

1 Schmitt, A. and Charles T. Brown. (2020, October 16). 9 Reasons to Eliminate Jaywalking Laws Now. https://www.bloomberg.com/news/articles/2020-10-16/jaywalking-laws-don-t-make-streets-safer

A protected bike lane in Tulsa.

3.4 PROMOTE EQUITABLE MOBILITY POLICIES

CHALLENGES AND OPPORTUNITIES

Tulsans who live in poverty spend a minimum of 38 percent of their income on costs associated with vehicle ownership.[14] Low-income Tulsans face the following mobility challenges:

- Low-income neighborhoods have limited access to transit routes, and many low-income Tulsans do not live near frequent transit.
- Safe biking and walking infrastructure are lacking in many places across the city.
- Transportation alternatives, such as bike share and e-scooters, are concentrated in wealthier neighborhoods.
- Transportation can be especially difficult for the unbanked, who lack access to credit cards or traditional banking arrangements.

There are a handful of initiatives in place to improve mobility equity in Tulsa. Tulsa Transit makes its services accessible to the unbanked by partnering with QuikTrip to sell bus fares. This Machine works with social service organizations to provide free bikeshare rides to their clients. The City has also aligned its Commercial Revitalization Strategy incentives to incentivize development along the BRT.

Tulsa also has plans to expand mobility equity with future projects and programs. For example, The GO Plan prioritizes low-income neighborhoods and those with low vehicle ownership for active transportation improvements. Connections 2035 seeks to improve the City's transportation systems for all Tulsans, and the City Health Improvement Plan includes transportation in its efforts to address access to healthcare and social determinants of health.

The City has an opportunity to build upon these successes to promote equity in its mobility policies.

BENEFITS

- **Increase equity**
- **Increase mobility options for low-income Tulsans**
- **Reduce the cost burden of transportation**

PARTNERS

- **Tulsa Health Department**
- **This Machine**
- **Tulsa Transit**
- **Bird, Lime**
- **Tulsa Authority for Economic Opportunity (TAEO)**

SAMPLE METRICS

- **Improved access to jobs/ education**
- **Reduction in household transportation costs**
- **Increase in low-income, low-vehicle ownerships census tracts with access to transit, micromobility, and bike share**

FUNDING

- **City of Tulsa**
- **Transportation Alternatives Program**

INNOVATIVE POLICY STRATEGIES

Transportation policies carry weight, as they guide how services are structured, infrastructure priorities are determined, and new capital investments are made. Due to the political nature of setting official policies that define laws and regulations, new policy can take a while to adopt. With Tulsa's widespread support for more equitable solutions, now is the time to make lasting policy change. The following strategies are key to advancing mobility equity in Tulsa.

A14. TRANSPORTATION DEMAND MANAGEMENT

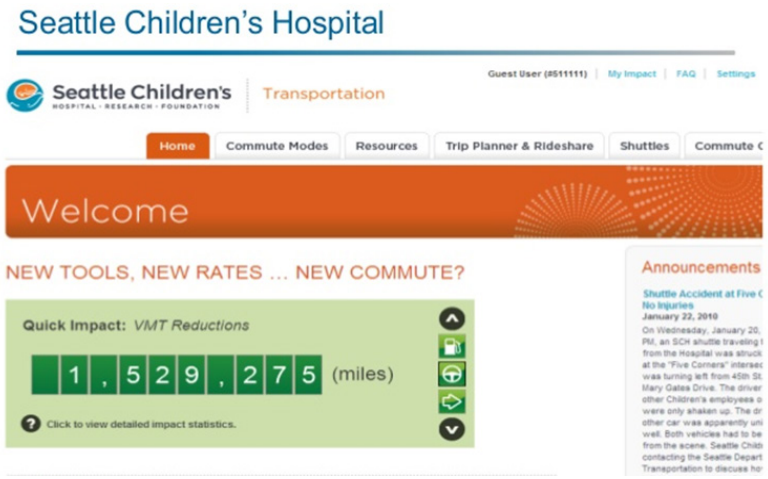
Transportation Demand Management (TDM) complements infrastructure improvements with information, encouragement, and incentives programs to change how people choose to travel. Forming Transportation Management Associations (TMAs) can help create good neighborhood-based leaders to spread the benefits of TDM strategies across the City. These independent organizations can work with stakeholders to carry out the improvements and enhancements that are most appropriate for a given neighborhood, such as non-English language materials. TMAs would be especially beneficial in employment centers such as downtown and the US-169 corridor. On a broader scale, Tulsa Transit could expand its GoPass app to include a gamified approach to TDM. This would encourage Tulsans to use alternatives to single occupancy vehicles through options such as dynamic trip planning, a points system for using more sustainable mobility options, and the potential to earn prizes or other incentives.

A15. TRANSIT BENEFITS/SUBSIDIES APPLIED ACROSS MODES

Transit benefits and subsidies should be integrated across all transportation modes to encourage seamless use of non-single occupancy vehicle options. For commuters, this would mean initiating partnerships between employers and Tulsa Transit, TNCs, and other stakeholders to establish employee benefit programs. Social service benefits should also be integrated across modes. While This Machine already offers free passes to some social service clients, micromobility providers should go farther by accepting Oklahoma Access (EBT) cards as payment. Future development of the Tulsa Transit GoPass app should integrate these payment options to increase equitable use of services.

CASE STUDY- Seattle Children's Hospital TDM Program

In partnership with technology vendor Luum, Seattle Children's created an in-house gamified TDM program that incentivized its employees to compete for recognition and rewards by driving less. The program has greatly reduced the need to drive, avoiding garage construction, while greatly reducing local emissions.



Source: Seattle Children's Hospital

A16. INVESTMENT STRATEGY PRIORITIZING TRANSIT, BICYCLE AND PEDESTRIANS

Current funding mechanisms prioritize transportation via single-occupancy vehicle. Moving forward, investment strategies should prioritize other modes to enhance mobility options for all Tulsans. Congestion alleviation funds such as CMAQ can be used to orient Tulsa's congestion policy towards demand reduction and promotion of other transportation modes. For instance, although not everyone will bike to work and school, supporting those who can choose to ride bikes can reduce the number of cars on the road for those who must drive. Non-bike commuters can enjoy the same infrastructure as bike-commuters through recreational rides. Similarly, roadway funding should be used to prioritize the importance of walkability and safety for pedestrians, bicyclists, and micromobility users. Parking pricing in high demand areas, such as downtown and Cherry Street, should be adjusted to reflect the true cost of parking; a study of the costs of parking for home and condominium owners would better inform the pricing decision. By restructuring the way transportation funding is spent, Tulsa can improve mobility for all of its citizens.

A17. LAND USE

Smart land use policies can be used to expand mobility for all Tulsans. Neighborhoods that have been disconnected by highways, such as the Greenwood District, should be reconnected by creating safe, pleasant linkages. Densification is an important strategy for increasing residents' access to mobility options. Densification in key areas, such as downtown, can be increased in a number of ways, including density bonuses, brownfield development incentives, parking reductions, and transit-oriented design zoning overlays. The City should ensure that densification is pursued in an equitable manner; certain neighborhoods, such as Midtown, are becoming expensive, and zoning code changes should be implemented to ensure "missing middle" housing strategies in these areas. Mobility should be tied to densification, for example, by meshing mobility hubs with new housing options.

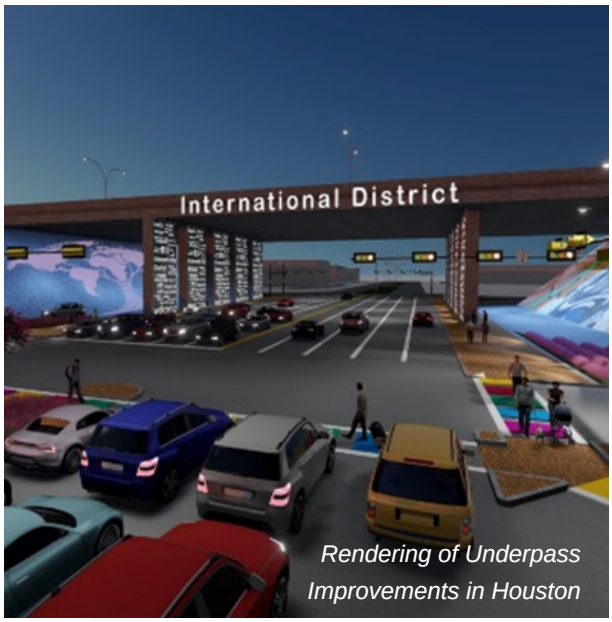
A18. CURB MANAGEMENT

As more mobility options become available in a given area, curb access will be in high demand. One of every city's most inefficiently-utilized assets is curb space. In most downtown and entertainment districts, curbs are reserved for a few prized parking spots – in Tulsa most of these parking spots are very cheap or free to use. The City can make curbs work better for the adjacent business owners and citizens who want to access those business or their services while generating revenue for the City by "digitizing the curb." Parking pricing should consider its users and equity impacts so it does not become a regressive tax.

Digitizing the curb means mapping the uses of the curb and using that information to provide smart zones for passenger pick-up and drop-off, as well as deliveries. Pilots of curb mapping and management in busy areas, such as downtown, could focus on providing access to the curb for all who need it. Revenue generated by these efforts can be used to fund transit, pedestrian, and cycling infrastructure improvements.

Bicycle infrastructure like along the River Park Trail makes bicycling more safe and enjoyable for riders of all levels.

CASE STUDY- Houston, TX Underpass Improvements



Rendering of Underpass Improvements in Houston

Stantec's H-GAC Livable Centers Study reimagined the International Management District's gateway. The proposed design creates a cohesive identity for the District while also improving safety and walkability for pedestrians, helping to reconnect districts divided by the highway viaduct.

Source: Public Radio Tulsa

Tulsa Transit services will grow in demand with new waves of workers choosing alternative ways of commuting.

SHORT-TERM ACTIONS

AS13. Ensure Bilingual Transportation Communications

Make transportation-related communications bilingual (English and Spanish), or utilize language demographics in certain areas (e.g., Global District) to make sure other languages are also accounted for in translation communications.

AS14. Partner With Community Organizations

Share information on shared mobility options and publicize the GoPass transit payment app.

AS15. Outreach and Education Program on Smart Mobility Options

Create a program to increase the comfort level with new options such as AVs, microtransit, and scooters by partnering INCOG with neighborhood organizations, community groups, and churches.

AS16. Subsidize Shared TNC Services

Tulsa Transit could explore partnerships with TNCs to provide subsidized connections to job centers and grocery stores.

AS17. Promote Smart Rezoning

Continue to promote the voluntary, mixed-use rezoning incentive program along the Peoria BRT route.

4. INITIATIVE B: MOBILITY INNOVATION POLICY

Creating policy tools that harness mobility technology

INITIATIVE B: MOBILITY INNOVATION POLICY

OVERVIEW

Bringing mobility technologies to scale in ways that advance equity, economic, and environmental goals depends upon adopting and adapting policies that break down silos, and rethink existing governance structures. Policies are needed to manage inevitable disruption from new service models, but also to ensure equity in accessing the benefits of new technology. The possible benefits of integrating new mobility services to support expanded shared mobility include:

- Access to essential goods and services, jobs, health care, and educational opportunities;
- Decreased costs associated with car ownership;
- Amenities which help attract and retain technology workers; and
- Improved safety and health outcomes.

While equity must be a cornerstone of Tulsa's mobility policies, expansion of new mobility innovation relies on policy strategies across multiple disciplines. Investments and programs in expanded shared mobility will address many of the equity challenges outlined in Chapter 1. Clear policy direction through an adaptable framework that tracks and considers new innovative services is needed to sustain these efforts, and inspire future actions that will reach people who are now underserved.

Expanded shared mobility services should be pursued in tandem with land use policy changes that incentivize the development of more walkable, mixed-use, and dense neighborhoods where people can live, work, and play without driving, or even needing to own, a vehicle. Mobility technologies that focus on shared and on-demand platforms align well with dense, mixed-use development. Even where existing development is less dense, creating safer streets and amenities that support walking, biking, and evolving forms of micromobility will make travel in Tulsa more equitable and less congested. This begins with continuing to improve the balance of funding across modes of travel, and maintaining active engagement with local communities.

A twenty-first century regional and local policy framework is needed to guide the deployment of emerging technologies, whether they are highly automated vehicles, e-bikes, e-scooters, electric vehicles, shared cars,

or shared rides. In addition to updating land use policies, this framework must include code amendments, revise regulations, provide plan updates, offer new design guidance, set new standards, and develop pilots and programs. The judicious use of pilots presents an opportunity to overcome many access-related inequities at a faster pace than waiting to move forward on major new services. Pilot programs also provide the opportunity to collect and analyze data to inform policy development. Key areas of policy focus include:

- Local and regional stakeholder and community engagement in piloting automated vehicles (AVs) for passengers and freight
- Procurement practices which accelerate proof of concept efforts and pilots by providing seed investment, creating new types of partnerships, allowing for the rapid pace of technology updates, and protecting trade secrets
- Data policies that provide consistency, transparency, and security and ensure that Tulsa's rapidly-emerging mobility innovations operate efficiently, safely, and equitably with user trust

This rendering depicts a vision for Sidewalk Toronto, which integrated technology as part of an engaging and walkable urban environment.

4.1 DEVELOP INNOVATIVE LAND USE POLICIES

CHALLENGES AND OPPORTUNITIES

While Tulsa's historic core neighborhoods display some remnants of the mixed-use and walkable city it was before World War II, Tulsa is primarily defined by the automobile age, with wide streets, a lack of sidewalks, single-use parcels, and homogenous land uses separated by excessive fields of parking. Streets and travel lanes are wide to accommodate the space-inefficient automobile, and they only grew wider as Tulsa grew. Other modes of travel are more space efficient, but are challenged by the great distances placed between destinations. In a culture where every new resident or job is assumed to add another car on the road, people sometimes fear that denser development will bring more roadway congestion—yet the opposite is true. If Tulsa was to see denser mixed-use development, the increase in non-automobile travel between nearby places would relieve congestion. Fortunately, Tulsa's planners are working to improve the City's land use policies.

Recent zoning incentives along the Peoria BRT corridor are promoting transit-oriented development proposals that capitalize on density and live-work-play environments. Reducing minimum parking requirements for development is a key part, especially where denser mixed-use development may necessitate expensive structured parking if too many spaces are required by zoning. In downtown, there are no parking requirements, but a legacy of auto-orientation produced a parking surplus that could be shared by future development with increased operational and regulatory flexibility. The City is actively studying how to add more housing in downtown to diversify its commercial uses, and sharing existing parking is an important way to meet the goal of making such housing affordable to the "missing middle" of Tulsans seeking to live in more active and dense neighborhoods. Other downtown and nearby policy initiatives are working to foster this walkable urbanity, including adding sidewalk dining, and parklets in curb lanes.

Car Share parking spaces should be centrally-located in developments to encourage their use.

BENEFITS

- **Creating more walkable development**
- **Supporting multimodal investments**
- **Reducing housing costs**

PARTNERS

- **City of Tulsa**
- **INCOG**
- **Land developers**

SAMPLE METRICS

- **Increased land use diversity**
- **Reduced percent of unused parking**
- **Improved jobs-housing ratio**

FUNDING

- **INCOG**

INNOVATIVE LAND USE POLICIES

The City of Tulsa has successfully implemented new mixed-use zoning and will work to accelerate and expand this effort citywide. Denser, walkable, mixed-use development can be directly tied to reducing the cost and space burden of automobile travel, helping to make Tulsa more multimodal and more equitable. Such development is highly compatible with shared and automated mobility, where human-powered or electrified low-speed devices and vehicles are the quickest and most effective method of travel among compact land use spaces. Policies that encourage this type of development by re-thinking and merging Tulsa's mobility, land use, and housing policies are needed, and can be promulgated in updates to building codes, design standards, and zoning requirements.

B1. UPDATE THE BUILDING CODE TO INCLUDE ACCESSIBILITY AND PARKING FOR SHARED MOBILITY:

Today, there are provisions in Tulsa's building codes for parking and driveway design, but there are no standards to promote the accommodation of shared mobility solutions, such as car-, ride-, bike- and scooter-share. Tulsa should develop shared mobility design standards for placement, size of parking areas, quantity of parking spaces, lighting, and security. Standards may treat short- and long-term rental options differently. Standards should also address curb ramps, easily-accessible automated door openers, when needed, and sufficiently large elevators when such parking is not at grade, and users need to bring bikes or scooters to another level. Front door or on-street curb loading for rideshare, microtransit and micromobility services need to be considered in all new developments of any size. Draft guidelines can be prepared and advertised next to new signature development proposals to present a cohesive message about smart mobility.

B2. REFINE PARKING REQUIREMENTS TO INCENTIVIZE WALKABLE, MIXED-USE DEVELOPMENT CITYWIDE:

Parking requirements drive up costs of development and create regulatory burdens to landowners and developers. The community loses when land is used for unecessary parking instead of retail, office space, and housing. This pattern of over-building parking hides the true cost of parking and entrenches the notion that parking is an entitlement. Reflecting the changing real estate market, incentives are needed that promote

Source: Images of downtown Seattle's 2nd Ave. from the International Sustainability Institute's Commuter Toolkit poster

Roadway investments should recognize that every mode besides the automobile is a more efficient use of space for moving people.

constructing fewer parking spaces in exchange for other amenities. Incentives will facilitate shared modes of travel, promote the sharing of underutilized spaces by off-site users, and remove landowner obligations to provide parking on their own parcel, or immediately next door. Incentives should be paired with bonuses for developers that create transportation demand management (TDM) programs. For example, developers can promote the use of active transportation and 'daylight' the cost of parking for consumers by unbundling the price of parking from monthly rent.

B3. CREATE NEW ZONING POLICIES THAT INCENTIVIZE DENSER, MIXED-USE DEVELOPMENT ALONG TRANSIT AND SHARED MOBILITY CORRIDORS:

Apply the existing mixed-use incentives along the Peoria BRT to other activity centers and corridors. Mixed-use- and transit-friendly zoning changes within a quarter mile of key transit corridors will prime Tulsa for more transit-oriented development. Potential zoning changes include incentives for building on-site transit and shared mobility infrastructure, reduced on-site parking, and participation in a transportation management association (TMA). A TMA should offer programs for commuters like micromobility membership, ride-share matching, dedicated shuttles, and employer-paid transit benefits. The City should continue to align economic development incentives to incentivize development along the BRT.

B4. UPDATE TULSA'S COMPREHENSIVE PLAN TO CHART TRANSIT-ORIENTED AND SHARED MOBILITY NODES AND CORRIDORS:

A citywide study to identify high-priority and long-term areas for greater density of mixed-use development is nearing completion. The results should be incorporated into Tulsa's next comprehensive plan update. Consistent with Tulsa's commitment to equity, the comprehensive plan can redirect investment towards places adopting mixed-use and transit-compatible zoning, or by incentivizing walkable places that are compatible with shared mobility. The plan should include quantitative performance standards to measure all progress towards key outcomes. Tulsa's comprehensive plan can pave the way for greater innovation, promote smart development, and attract employers drawn to Tulsa's smart mobility ecosystem.

CASE STUDY-
Somerville, MA Rezoning

In 2019, the Cityof Somerville approved a highly-collaborative, seven-year effort to overhaul its zoning for the first time since 1990. The form-based code was specifically designed to help accomplish nearly 200 objectives identified in the SomerVision2030 master plan. Some of the major successes in the code set the stage for significant improvements supporting equity, and opportunities for connecting people to mobility options, such as:

- Minimum parking requirements repealed for many areas
- Parking maximums established in all areas within walking distance to MBTA stations
- Robust minimum bicycle parking requirements
- Requirement of higher density buildings and larger businesses to submit Mobility Management Plans and implement TDM programs & services
- Entitlement of mixed-use, transit-oriented, high density through Overlay Districts and a Master Plan Special Permit approval process
- Requirement of the majority of new development to provide 20 percent of new units as affordable dwelling units

BS1. Conduct a Parking Cost Evaluation

Collect local data and determine the one-time and monthly cost per-space of recent surface and structured parking facilities- inclusive of land acquisition, hard and soft construction, and monthly maintenance and operations- to establish a local index of parking costs by facility type. Parking costs should be compared with the total size and development cost for any associated building(s), using each parking area to determine the percentage of development costs by land use type associated with parking. Subtracting fee revenues—if any—from the parking cost establishes the subsidy paid by development to accommodate driving, which can be contrasted with the cost to instead subsidize shared mobility. Shared broadly with local developers, realtors, and the business community, this data can help establish a financial basis for shared mobility investments.

BS2. Conduct On-Street Parking Evaluation of Parklet Program Impacts

On-street utilization and meter revenue data demonstrate that there is capacity for parklets and other more active front-door uses, and this data counters perceptions that front-door parking is essential to merchants. By conducting surveys, focus groups, and workshops to identify stories of success and areas for improvement with recent parklet deployments, the City can build support for long-term pilots of more active curb lane uses, including “streateries” for dining, bike parking, micromobility docks, rideshare stations, and more.

BS3. Expand Parklet and Curbside Lane Permitting Programs to Incentivize Walkable Streetscapes

The recent successes with curb lane conversions and new bike lanes should be permitted on other downtown corridors and surrounding neighborhoods.

A curb lane converted to dining space in downtown Tulsa.

4.2 LEVERAGE DATA FOR INFORMATION

CHALLENGES AND OPPORTUNITIES

Data is the currency of new mobility. Ubiquitous, real-time mobility data supports safe and efficient shared mobility. Location based service (LBS) data streams make the rideshare, shared micromobility, and home delivery industries possible. Smart phones, retail transactions, parking occupancy sensors, bus passenger counters, transit fare cards, onboard performance sensors, smart traffic signals, and roadside infrastructure all stream data. That same data has spurred innovation in asset management, traffic management, emergency response, maintenance, operations, and rider experience. By sharing data, robots can deliver packages autonomously, microtransit can divert to your house, rideshare cars can be re-routed mid-trip, and aerial drones can fly across and between cities carrying organ transplants, educational materials, food, medicine, and more. This data is transfered through automated programming interfaces (APIs) that should be subject to common standards which allow locational data to be shared by providers, informing operators, riders, and planners about the real time locations of shared rides, buses, bikes, scooters, and more. Some industry standards such as the General Transit Feed Specification (GTFS) and bike share data through the General Bikeshare Feed Specification (GBFS) have been used by various cities and regions for over a decade. Other data streams such as those for micromobility (Mobility Data Specifications-MDS), paratransit and on-demand services (GTFS-Flex), and Mobility on Demand (MoD) platforms have evolving standards. Meanwhile, connected and automated vehicles will generate an exponential amount of new data in coming years. This includes the locational, environmental, optical, radar, laser-ranging (lidar), and infrared data that allows artificial intelligence (AI) to "drive" vehicles.

Tulsa has embraced the use of mobility data. With its Urban Data Pioneer initiative, Tulsa engages citizens in the use of data to improve services and quality of life. The City and its business and community leaders have jointly studied the insights of Inrix mobility data and the Bloomberg/Aspen Institute's analysis of city readiness for autonomous mobility systems. The City and the region have adopted existing accepted data standards and have tapped into LBS data, such as that provided by Streetlight, to plan improved transportation operations and future solutions. Furthermore, the City is in the early stages of locating new sources of data, including about street level activity across modes of transportation, data used to manage the curb, and more.

BENEFITS

- **Protecting users' privacy**
- **Enabling faster roll-out of solutions**
- **Attracting innovators**

PARTNERS

- **City of Tulsa**
- **INCOG**
- **Universities**
- **Local technology innovators**

SAMPLE METRICS

- **Availability of real-time data by mode of transportation**
- **Number of end users**
- **Number of data subscribers**

FUNDING

- **Foundations**
- **State and local government**
- **Subscribing vendors**

Tulsa must navigate a complex set of data issues as it looks to create an integrated mobility system across multiple shared modes of travel. The same data streams that make operations safer and more efficient must be shared and optimized through open and interoperable systems that any mobility provider can read and contribute to, without delay. The challenges begin with common data standards.

Many of these digital data streams are non-standardized, with many interests seeking access and control of data to support specific business cases. There is often tension between the public and private sectors over data sharing, especially with respect to making data open source. The role of data to support the future of mobility includes other considerations such as governance, management, and sharing. Issues that should be considered in data governance and use policy include:

- Data licensing and ownership
- Privacy and data security
- Data verification, especially where data is used for regulatory and program management purposes
- User trust and consent
- Storage, management, and retention periods
- Open records and law enforcement requirements

INNOVATIVE DATA POLICIES

A data governance and use policy communicates goals and benefits around the responsible and transparent use of data to enhance mobility. Tulsa can facilitate mobility innovation and its related benefits of equity and economic development by enacting policies that facilitate data sharing. Tulsa is already using data for pilot programs around the use of artificial intelligence to promote safety and greater municipal services, including the use of data analysis for code enforcement. This work provides the foundation for a data governance and use policy that promotes the responsible and transparent use of data, and that aligns with the goals and interests of both the public and private sectors.

B5. DESIGN A DATA COLLABORATIVE:

The work of the City's Office of Performance Strategy and Innovation (OPSI) and its sustainability plan provide the building blocks for a data governance and use policy. OPSI, the City's current data policy task force, could also design and administer a data collaborative. This collaborative could:

- Refine and appropriately target use cases for data, reduce the risk of overcollection, and assess methods to protect the privacy of users of mobility services
- House data for a growing base of developers and vendors seeking the testing and deployment of innovative mobility solutions
- Lead education focused on understanding the risks of data sharing and use
- Promote initiatives that teach the audience to complete privacy risk assessments that promote the responsible sharing of data in line with best practices and evolving regulations
- Develop a program of pilots that can monetize data generated through the use of public infrastructure

B6. DEVELOP A CITYWIDE DATA GOVERNANCE FRAMEWORK

Building from the current task force, Tulsa should develop a cross-department Data Commission charged with developing use cases, assessing risk, and conducting outreach to public and private stakeholders. The Commission should include City departmental representatives, private operators and researchers, academic partners, privacy advocates, and direct community representatives. The Commission can be charged with developing a data governance framework that considers:

- Data licensing and ownership
- Privacy and data security
- Data verification when used for regulatory and program management purposes
- User trust and consent
- Storage, management, and retention periods
- Open records and law enforcement requests

The Data Commission should recommend a fair and equitable framework for collecting, storing, managing and sharing data of any type. These recommendations consider best practices around data management and security with a particular focus on protecting any data that contains personally-identifiable information or which could be used to re-identify a user. A defined data owner and manager should be established to provide accountability to the public trust. The framework should ensure data is openly shared at different levels of ownership based on identified need and with appropriate risk management.

B7. PILOT DATA REVENUE OPPORTUNITIES

OPSI, with the advice of the Data Commission, should oversee pilot opportunities that include shared revenue streams from data being collected through the use of public resources (e.g., use of public streets and sidewalks or traffic and lighting infrastructure to mount sensors). A shared revenue stream may be generated through subscriptions or usage fees, terminal access fees (including at curbsides), or payments by insurers and advertising. Possible pilots also might include fee-based curbside management solutions or developing revenue sharing opportunities from new infrastructure in the public space that supports shared mobility, such as micromobility docks. Any revenue-focused programs based on data should ensure appropriate notices are provided to users with consistent privacy policies.

CASE STUDY- San Diego Regional Micromobility Coordination

Source: San Diego Association of Governments

San Diego's Association of Governments (SANDAG) established a Regional Micromobility Coordination effort as a support system for local agencies. The key goals are to support jurisdictions during the deployment of micromobility programs (such as the Neighborhood Electric Vehicle program in the image at left) and build consensus among cities and stakeholders when establishing data sharing protocol, defining areas for micromobility parking and loading, and conducting public outreach and education.

In 2019 a collaborative effort resulted in the development of regional micromobility data sharing requirements.

CASE STUDY- Chattanooga and The Center for Urban Informatics and Progress (CUIP)

Tech-forward Chattanooga is one of two U.S. cities participating in a global initiative to test out data-related policies in the Smart Alliance Road Map. This follows the City's recognition at The Smart 50 Awards (2020) for ethical and transparent data practices.

Chattanooga's transportation data testbed is located along a smart corridor, and is a real-world environment that is plugged into the city's fiber optic network. It provides instant communication between the testbed infrastructure and vehicles or people on the street, but community privacy is built into the design. Although video images are processed into anonymized data when collected, the footage is deleted. Through CUIP, terms for data usage were defined, and data will only be shared with parties who follow their practices.

SHORT-TERM ACTIONS

BS4. Establish Data Commission

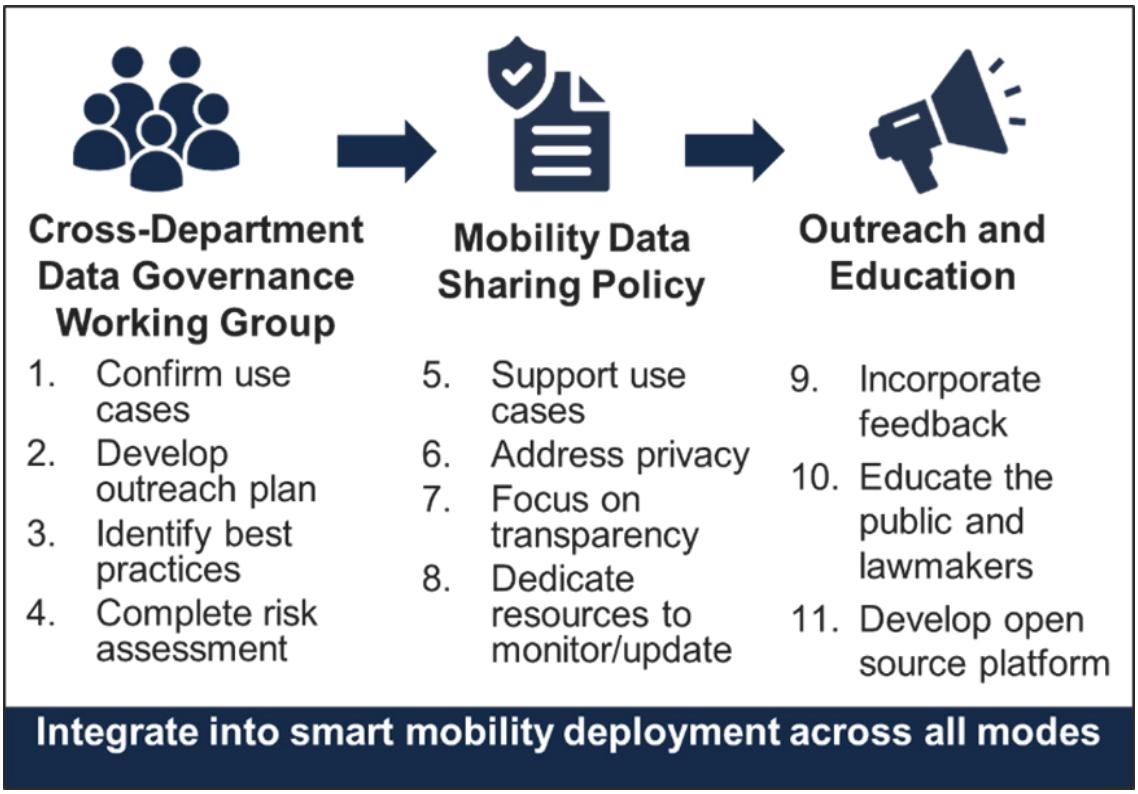
Review charter and membership and revise as needed to clarify roles and responsibility as well as ensuring appropriate membership from internal and external stakeholders.

BS5. Identify Use Cases for Data

Develop and conduct risk analysis for use cases that support goals around enhanced services for residents.

BS6. Identify Best Practices for Protecting User Privacy

Best practices for privacy protection include avoiding collection and retention of data that identifies users in the first instance—so-called privacy by design. Best practices should also address instances when data includes the user's identity or could be reused to re-identify individuals.



This series of simple steps creates organization and transparency between parties when establishing data sharing and privacy practices.

Source: Stantec

4.3 ACCELERATE AUTOMATED VEHICLE INNOVATION

CHALLENGES AND OPPORTUNITIES

Tulsa seeks to advance high-value use cases of automated mobility in the city. These use cases include safety applications at lower levels of automation as well as highly automated vehicles (HAVs) such as shuttles for fixed route, circulator, and mobility-on-demand applications. As AV technologies advance—especially with a heightened focus on freight applications for long-haul, middle-mile, and first- and last-mile delivery—Tulsa has an opportunity to be in the vanguard of applying these technologies in a mid-sized city and in providing opportunities to bring the technology to scale.

Over the last several years the City, higher-education community, and local business leaders have focused on Tulsa's substantial research and infrastructure assets for supporting AVs. Tulsa's stakeholders have been active in a statewide legislative policy study and taskforce as well as local and regional initiatives to secure funding. In 2020, the State legislature approved SB 365, which explicitly permits AVs to operate on-road for the purpose of pilots. The State's Transit Policy Plan identifies AV applications in transit as a priority. The City of Tulsa, Tulsa Transit, and INCOG have recently identified potential sources of initial public funding for an AV pilot or pilots in the region.

Even with these advancements, the City of Tulsa and INCOG need to continue education efforts with respect to the legal status of AVs in Oklahoma and funding opportunities. In addition, the City and MPO are advised to monitor Federal policy as it relates to the certification and testing of AVs and funding of research programs related to AVs, which is expected to continually evolve as their technological capabilities increase.

BENEFITS

- **Speed the deployment of automated vehicles**
- **Advance equitable shared solutions**
- **Improve the safety of Tulsa's streets**

PARTNERS

- **City of Tulsa**
- **INCOG**
- **State of Oklahoma**
- **Universities**

SAMPLE METRICS

- **Local mile traveled by AVs**
- **Number of shared seats available**

FUNDING

- **INCOG**
- **Private technology partners**
- **Private and university campuses**

INNOVATIVE AUTOMATED VEHICLES POLICY

Tulsa is now well-positioned to move forward with a program of AV pilots across modes. The passage of legislation authorizing pilots of autonomous vehicles on public roads resolves questions of legality. Furthermore, Oklahoma's Transit Policy Plan calls out Tulsa as a venue for a potential transit-focused application of AV technology. This reflects ongoing efforts in public, private, and research sectors that place Tulsa in the forefront of AV readiness and in advancing investment in this key technology.

B8. ESTABLISH CITY/INCOG TASK FORCE TO PLAN, FUND, AND EVALUATE AV PILOTS ACROSS MODES

Building on the statewide policy task force, create a regional working group or task force to guide a program of pilots across modes. The regional working group would include public, private, and non-profit stakeholders. The remit of this group would be to:

- Confirm the legal framework for safe operation of AVs on public roads, including developing guidance or regulations
- Plan community outreach, develop monitoring and evaluation of the safe operations of vehicles, and engage with and prepare first responders, including law enforcement
- Make AV and shared mobility readiness investments in public and private infrastructure; infrastructure would include mobility hubs, first- and last-mile shared mobility rights-of-way, and electric charging
- Foster a program of AV technology demonstration projects (a program of projects or "POP") across modes and operating areas, including downtown, academic and business campuses, the airport, the river port, and the Osage Nation tribal lands; these projects would include proof of concept demonstrations, pilots, and fleet deployments of AVs encompassing both freight and passenger use cases
- Coordinate with the Downtown Tulsa Partnership, public-private-philanthropic partners, Tulsa's Innovation Labs, and the proposed Innovation Challenge on related mobility innovation initiatives
- Participate in the statewide AV policy taskforce as a means of developing replicable approaches to public education and community engagement, coordination with emergency management and law enforcement, and data governance, management, and sharing requirements

The Responder Safety Learning Network offers a course to first responders on AV technology and challenges.

CASE STUDY-
Minnesota CAV Challenge

Minnesota's Department of Transportation (MnDOT) invited industries, non-profits, businesses, and the public to participate in a $5 million Minnesota CAV Challenge.

The open procurement process encouraged proposals in categories including automated fleets, autonomous shuttle pilots, and connected vehicle technologies, and provided opportunities for workshops with MnDOT during the development of ideas.

To date, MnDOT has held over 57 (privately-hosted) partnership meetings, met with over 100 organizations, received nearly 40 proposals, and awarded 12 projects.

Source: America's Transportation Awards

CASE STUDY-
AVShuttle Utah

In spring 2019, The Utah Department of Transportation (UDOT) and the Utah Transit Authority (UTA) partnered to launch an Autonomous Shuttle Pilot.

A series of locations around the state were selected for the testing based on their proximity to transit, density of visitors, and access to storage and charging facilities.

One of the most important parts of the pilot was educating the public about AVs and gauging their interest in shuttles being integrated more broadly in the future.

Of those surveyed (of 6,612 riders):

- **95%** felt AV shuttles could complement public transit
- **98%** of riders felt safe on board

Source: AASHTO Journal

SHORT-TERM ACTIONS

BS8. Confirm Conditions of On-Road Operations of Automated Vehicles

Take appropriate steps to confirm that Oklahoma State law allows for the deployment of automated vehicles on public roads across modes beyond deployment of pilots. Such vehicles should comply with Federal Motor Vehicle Safety Standards.

BS9. Convene Public-Private-University Working Group

Start by identifying public stakeholders and research partners and then add to the roster technology firms, other public agencies, investors, nonprofits, and residential and commercial property developers. The working group would facilitate the understanding of policy, planning, and technology readiness. Furthermore, the group would assess and propose a sequence and sites for the demonstration, piloting, and deployment of AVs across the region and across modes.

BS10. Launch the First Project in a Progam of Pilots

A single pilot can advance several strategies, including building safety oversight at the state, regional, and city level, advancing shared mobility and transit, stimulating the development of vehicles that are accessible, and tapping Tulsa's research and technology capabilities, including safety evaluation and cybersecurity programs of local universities and Tulsa's Innovation Lab. Furthermore, data collected from pilots can be used to inform data driven policies and regulations. Candidate locations for such projects include the TEU Campus, Downtown Tulsa Partnership, Tulsa Airport, and Greenwood.

BS11. Showcase Tulsa/INCOG AV Readiness and Mobility Innovation

Create buzz and support for shared mobility and AV solutions through launching demonstration projects, hosting technology-exchange conferences, marketing local venues as technology proof-of-concept efforts, and developing an innovation challenge.

Innovation conferences like these are key for introducing new technologies and potential partnerships.

4.4 REMOVE BARRIERS TO LOCAL INNOVATION

CHALLENGES AND OPPORTUNITIES

Tulsa is home to innovation leaders in the private sector. However, they are leading fledgling initiatives that need partners to fund them and venues to test and pilot their innovations. Furthermore, Tulsa's equity and economic development goals require bringing mobility innovations to scale. Success hinges on public cooperation through pilots, partnerships, and leading-edge procurement processes.

Traditional public procurement requirements and timeframes are very burdensome for the pace needed to support innovation cycles of software development sprints and new infrastructure testing and refinement. Automobile manufacturers have constructed massive private test tracks to perform these functions outside of procurement requirements. Today's mobility innovators need to develop and pilot solutions at a far faster pace than new car cycles, but typically without the accommodating environment of private test facilities. Cities like Tulsa can respond by becoming partners and test beds for many solutions; however, their procurement rules remain significant obstacles.

Similar to the need to develop data use and governance policies to track the new electronic "fuel" of mobility innovations, traditional approaches to contracting and procurement need to be modernized to ensure the safest and most up-to-date technologies are being integrated into the transportation system.

Public procurement requirements exist to serve key public interests. These include ensuring that representations of skills or materials are factually accurate, business and financial practices are sound and legal, liability protection is sufficient, appropriate communications are made to impacted entities, competition is fair and equitable with smaller or disadvantaged businesses offered equal opportunity, and companies do not discriminate. At the same time, Tulsa's procurement process has accreted many requirements and been slow to allow basic transparency into status of reviews and payments.

Modernization of procurement can reduce costs and reduce the upfront time of initiating work. Alongside such efforts, Tulsa can tap innovative approaches to funding and partnering in the piloting of new technology and can develop new contracting and permitting mechanisms that speed up the typical procurement process. This may require a commitment to increased City staffing in contracting, legal review, and technical support.

BENEFITS

- **Attract local innovators**
- **Keep Tulsa viable for innovation**
- **Attract funding for innovation**

PARTNERS

- **City of Tulsa**
- **Federal Highway Administration**
- **Downtown Tulsa Partnership**

SAMPLE METRICS

- **Number of smart mobility contracts let**
- **Number of local innovators**
- **Average reduction in deployment time**

FUNDING

- **City of Tulsa**
- **Private partners**
- **State Innovation Fund**

INNOVATIVE PROCUREMENT POLICIES

Drawing upon momentum demonstrated by the City's interest in supporting the Downtown Tulsa Partnership, Tulsa should seek to form additional opportunities that can both accelerate mobility innovation projects as well as create successful precedents which help public sector agencies improve their procurement processes. By involving the City and multiple public and private partners, a downtown mobility lab is an immediate opportunity to test rapid and innovative procurement and/or permitting processes. However, many more partnerships are needed across the region and outside of the downtown.

B9. MODERNIZE CITY PROCUREMENT PROCESS

First, the process needs to be efficient, inviting, and transparent. Transform the procurement program into a results-driven approach which focuses on outcomes of programs and services, elevates procurement as a strategic function, and invests in equity to improve economic mobility and better outcomes for those that were historically marginalized. Often, the tendency to recycle Competitive Sealed Proposals (CSPs) or Invitation for Bids (IFBs) fails to account for the current state of new technology. One approach to this would be to focus on a longer market research period before issuing Requests for Proposals (RFPs).

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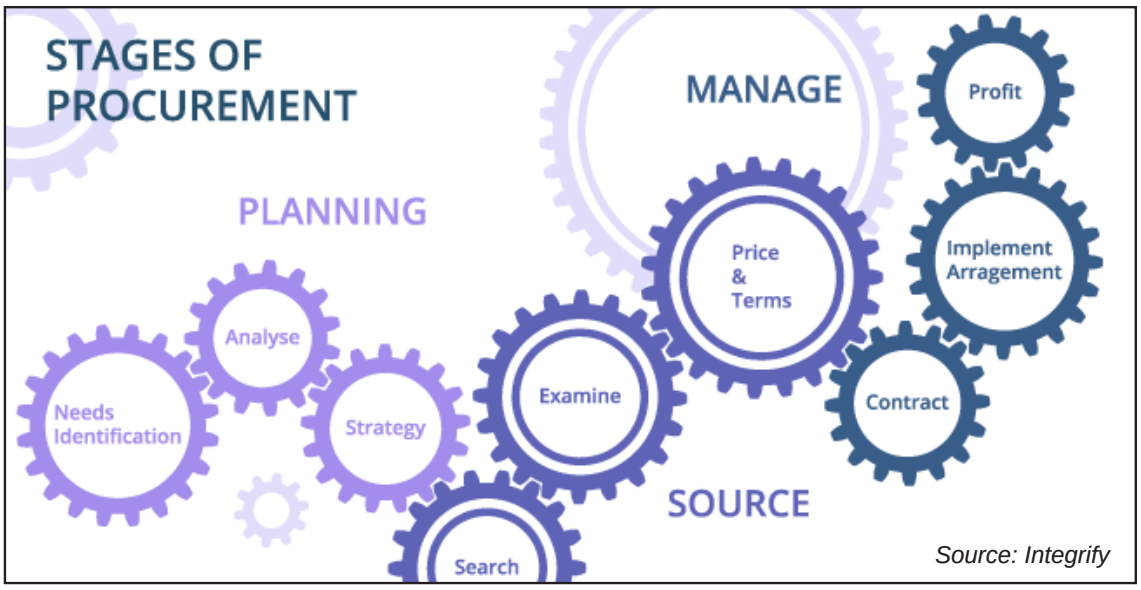
B10. CREATE PROGRAM OF PILOTS TO BRING INNOVATION TO SCALE

Tulsa should design an approach to pilots that focuses on addressing key mobility challenges, structures pilots that can scale to sustainable business models, and fosters innovation by allowing for multiple iterations. A program of pilots, rather than a series of one-off projects, may also curtail or avoid time-consuming procurement processes. Tulsa has witnessed an uptick in pilots and incubators providing support for start-ups. Tulsa Transit led efforts in piloting and deploying Mobility-as-a-Service trip planning and payment and is looking to move forward with expanded alternative services. The Osage Nation lands are home to drone testing and pilots. The Downtown Tulsa Partnership is positioned to coordinate partners and funding streams to pilot solutions, including micromobility hubs, AVs, and curbside management solutions that meet economic and mobility needs in downtown. Using a mobility innovation lab approach combined with modernized procurement processes, Tulsa can make a program of pilots more attractive to private sponsors.



The stages of procurement should be outlined in a logical way.

B11. DEVELOP A PUBLIC-PRIVATE FUNDING PLAN COLLABORATIVELY WITH PRIVATE FIRMS, UNIVERSITIES, AND REGIONAL PHILANTHROPIES

Many Federal grant programs require demonstrated partnerships and funding from non-Federal sources. In preparation for routine and new Federal funding opportunities, the City of Tulsa should develop a list of potential sources of matching funds, including local resources, private funding, foundation grants, and in-kind contributions. This might be complemented by a grant support function that catalogs potential funding opportunities and resources for writing proposals.

B12. SUPPORT THE STATE PILOT INNOVATION FUND

Explore authorizing existing appropriations as matching or seed money for technology innovation projects. This effort may begin as a pilot allowing a percentage of existing State funds to be used for piloting transportation technologies. The Minnesota Connected and Automated Vehicle Innovation Challenge and Virginia's Innovation Fund provide examples that could be tailored to Oklahoma's environment.

B13. SECURE LOCAL/REGIONAL P-3 AUTHORIZATION

The establishment of a public-private partnership (P-3) is one of the most telling indications of a region that is ready to attract financing for innovation. Moving beyond handshake collaborations and MOUs, a legal P-3 entity has the power of pooled resources, industry expertise, and public procurement and permitting know-how. Establishing a P-3 in Tulsa is possible today but only with special legislative approvals. Special authorization of P-3 entities should be approved in Tulsa to help accelerate the pace of mobility innovation and attract significantly greater funding on a recurring basis. Any requested authorization should propose a governance structure that modernizes procurement and open records requirements in line with promoting new technology-focused opportunities.

CASE STUDY- Louisville, KY Strategic Procurement System

Through the Bloomberg Philanthropies' What Works Cities initiative, technical assistance was provided by the Government Performance Lab (GPL) to Louisville (and 29 other cities) to design and pilot strategic procurement systems for improving the outcomes of City-contracted dollars.

Louisville established a new Strategic Procurement Committee, comprised of senior department leaders, for the systematic review of high priority contracts. The Committee meets quarterly to review contracts approaching expiration, and identifies recommendations for improvement. They also review purchasing data for trends to inform needed policy adjustments and system-wide changes.

Source: What Works Cities

SHORT-TERM ACTIONS

BS12. Establish a Mobility Innovation Challenge

In collaboration with regional universities and incubators, host a "Tulsa Mobility Challenge" in collaboration with partners such as Oklahoma University, the Oklahoma City Community Foundation, OK Catalyst, Google, or Amazon. This might be hosted in conjunction with the Downtown Tulsa Partnership and with the Tulsa Innovation Labs.

BS13. Catalog Funding Sources (Public and Private, Federal, Regional, State)

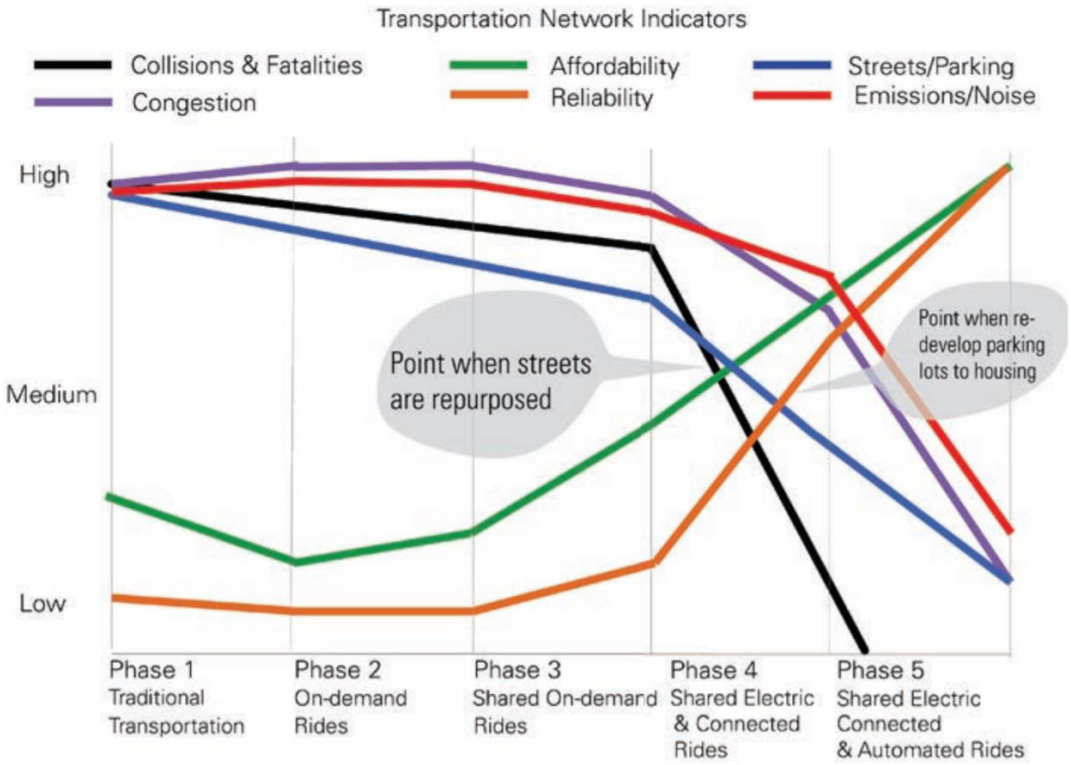
Broader funding opportunities from public foundations, Federal agencies, regional governments, and the State of Oklahoma should be cataloged as future opportunities for support of mobility innovation.

BS14. Seek a Legislative Study of Innovation Funding and Financing for Transportation

The legal authority to establish P-3's that pool financing options and possibly attract public funding should be studied and a framework for establishing a mobility partnership in Tulsa drafted.

BS15. Collect Best Practices in Innovation Partnerships with Regional and National Foundations:

Increasingly, Tulsa-based regional and national philanthropic foundations are collaborating to bring innovations to address social and economic development issues. Tulsa should crowd-source information on best practices in developing public-private-philanthropic partnerships through surveys, expert interviews, and a virtual workshop.



Source: SFMTA

This diagram provides an overview of 12 USDOT Vision Elements that will collectively support the implementation of Shared Electric Connected Autonomous Vehicles (SECAV) in San Francisco.

4.5 MAKE TULSA A LEADER OF SAFE AND SHARED MOBILITY

CHALLENGES AND OPPORTUNITIES

Tulsa happens to have high potential to become a national leader in shared mobility because of both great motivation and great need. Public and private partners have coalesced around the strategies in this MIS as a result of growing efforts by all parties to implement successful and lasting mobility innovations that benefit all Tulsans. They are working in a region that is in great need of such improvements and is hence very motivated to accelerate the pace of change.

Long an auto-oriented city with little funding for transit, walking, or biking infrastructure, Tulsa continues to be plagued by disconnected multimodal networks and excessive pedestrian and bicycle crash rates, while the greater wear and tear of private automobiles demand ongoing investment to maintain roads without increasing their carrying capacity. Shared mobility solutions bring the potential to serve many people more safely and far more affordably with less infrastructure cost, and reduced costs are becoming essential as gas tax receipts are declining precipitously due to ever increasing fuel efficiencies and failure to index gas tax to inflation.

Tulsa's non-auto infrastructure needs are gradually being overcome but, citywide, many significant sidewalk gaps remain. Access for those in wheelchairs, using walking sticks, or traveling with hearing impairment is very difficult, with safer accommodations missing citywide. New biking facilities have been installed recently, but the citywide network is lacking. Many bus stops have no landing pad or safe crosswalk nearby. Even where these and other multimodal needs are met, the overall perception of poor accommodations limits the potential for those who might seek to venture out without a car, especially if they feel more vulnerable—and particularly at night.

A notable challenge is that current City policies need to mature to better support other modes of travel. Roadway funding and reconstruction programs rarely include walk or bike infrastructure improvement or expansion, and transit amenities are currently only the responsibility of the transit agency, not the City which funds the streets and sidewalks that transit needs to use. Tulsa lacks a "vision zero" policy that—like hundreds of American cities—commits to a goal of reducing traffic fatalities to zero. Implementing such a policy would directly target needed walk and bike improvements, since walking and biking have the highest crash and fatality rates per mile traveled.

Fortunately, Tulsa's shared mobility partners have long seen these challenges and are galvanized

BENEFITS

- **Foster a mobility innovation culture**
- **Attract funding & partners**
- **Expand awareness of shared options**

PARTNERS

- **City of Tulsa**
- **INCOG**
- **Universities & foundations**
- **Business associations**
- **Non-profit organizations**
- **Tulsans citywide**

SAMPLE METRICS

- **Number of official partners**
- **Funding dedicated to shared mobility**
- **Participation rates**

FUNDING

- **All partners**

behind finding smart solutions as soon as possible. Through recent public and private partnerships, superior solutions have been tested and developed, including the growing success of the “This Machine” bike share, the broadening deployment of e-bikes and e-scooters across more parts of the city, and the installation of a growing, connected bike network.

Tulsa Transit is now regularly launching new improvements, from new service and fixed stops to on-board wi-fi and bus location services. The Peoria BRT is not only a cutting-edge transit spine, it also has prompted the development of walkable transit-oriented nodes along its route. The city is seeing walkable and bikeable places that are ready for the deployment of shared mobility cropping up citywide, from the Gathering Place to the Pearl to downtown to the four college campuses located throughout the city. Plans are in place to dramatically expand bike share, electric vehicle charging, and bike lanes citywide. Seeing such changes coming, the Oklahoma State Legislature has recently filed legislation to allow road user charges to supplement and eventually replace the gas tax, opening up new streams of revenue for non-auto improvements. While Tulsa’s needs remain great, the pace of change and incredible local and statewide momentum to advance mobility innovations is a golden opportunity for Tulsans.

INNOVATIVE SHARED MOBILITY STRATEGIES

To support a rapidly-changing mobility landscape and ensure the long-term success of Tulsa’s investments in non-auto shared mobility solutions, innovative policies are needed to guide investment, attract funding, and create a citywide ecosystem. A number of strategies are needed.

B14. INVEST IN SAFE PLACES TO WALK, BIKE, AND SCOOTER

Multiple opportunities exist throughout Tulsa to make the safe places that attract shared mobility solutions, especially by building off of and connecting with existing successful nodes. Many districts and campuses can build this network and link nodes with the right set of policies and investments in place. Tulsa should be directing investment disproportionately towards these shared mobility places to foster a more efficient, safe, and equitable transportation network that attracts investment, innovators, and jobs- supported by new “vision zero” and “complete streets” policies. A number of short-term paths exist to stimulate broader investment, including expanding micromobility funding by redirecting sources such as CMAQ (the Federal Congestion Mitigation and Air Quality program), streamlining procurement and permitting in targeted walking districts, and making “complete streets” standards the requirement for all future roadway reconstruction and expansion projects to help ensure that non-auto shared mobility is possible. Building coalitions of support and funding to drive this strategy will be essential.

CASE STUDY- Seattle’s Transportation Electrification Blueprint

In March 2021 the City of Seattle released a first-of-its-kind plan developed to move towards a clean (environmentally-conscious) and equitable transportation system. Immediate policy changes and infrastructure improvements are recommended to help achieve the plan’s 2030 goals, including zero emissions for:

- **100%** of shared mobility
- **90%** of all personal trips
- **30%** of goods delivery

B15. INITIATE REGULAR COMMUNITY ENGAGEMENT ON SHARED MOBILITY

All public and private partners seeking to deploy shared mobility innovations on the streets, sidewalks, waterways, and airways of Tulsa will necessarily need to find supportive populations to use emerging solutions and have vehicles and right-of-way changes on their roadways. An ongoing program of regular community engagement will be needed to support Tulsa's innovations in mobility. This should begin soon with a citywide education campaign that is focused on achieving "vision zero," is supportive of existing shared mobility solutions, and advertises upcoming mobility pilots. Tulsa needs to stop tolerating traffic fatalities and focus heavily on the equity, economic development, and safety benefits of a mobility innovation ecosystem. There are many successful programmatic models for outreach, with equitable outcomes being advanced recently in Boston from GoBoston 2030, in Minneapolis as a result of Minneapolis 2040, and San Francisco's Vision Zero Policy. Tulsa can generate an infectious buzz amongst Tulsans that motivates its public and private partners to accelerate the deployment of innovative solutions by embracing safer, multimodal street for all ages, means, and abilities.

B16. EXPAND & CONNECT WALKING AND MICROMOBILITY NETWORKS

While mobility innovation is already underway, significant deployment success will be limited until safer non-auto networks exist across the city. Strong walking and micromobility networks exist in or near downtown and The Gathering Place, with newly developed connective lanes in between, but more needs to be done to make these facilities truly protected and buffered for users of all ages and to expand their reach beyond these two areas. Tulsa is fortunate to have a well-developed street grid with multiple parallel through streets between arterials. This provides opportunities to create an extensive and safe micromobility network without the challenge of heavier automobile traffic, while also connecting neighborhoods, campuses, and schools with each other and downtown. A targeted investment program is necessary, supported by a new set of design standards that incorporate complete street principles that have been developed for similar cities, such as Fayetteville, AR—with guidance readily available through organizations such as the National Association of City Transportation Officials (NACTO). An early deployment of multimodal sensors (i.e., Numina) can spark deployments by finding routes with lower conflicts and greater front-door pedestrian activity.

B17. INTEGRATE PEDESTRIAN SAFETY IN DOWNTOWN MOBILITY PROGRAMMING

Even though places like downtown are rapidly becoming more walkable, Tulsans generally drive for most trips and are not accustomed to walking very far or using non-auto modes. While a walkable district replete with walking-oriented destinations and micromobility connections is already a very successful and spreading model in many American cities, Tulsa has yet to see extensive pedestrian activity in any district. However, by deploying a variety of safety improvements on a block or across a pilot district that prioritize pedestrians and encourage front door activity at local destinations and businesses, Tulsa can quickly create the critical mass to make a real walkable district and attract the patrons needed for shared mobility options. Beginning with traditional techniques like travel lane narrowing, crossing improvements and signals, traffic calming devices, and on-street parklets, Tulsa can test new safety technologies such as leading pedestrian intervals at signals, passive crossing detectors, adaptive signal timing, in-pavement dynamic lighting, activity counters, interactive wayfinding kiosks, and more. Innovators can test multimodal sensors, connected vehicle technologies, automated taxi deployment, and other solutions. Most importantly, downtown walkability improvements can be a springboard to a Tulsa-wide mobility innovation ecosystem.

B18. EXPAND ACCESS TO MICROMOBILITY

This Machine is a leading example of how to deploy and rapidly expand a bike share system. The system has reacted to community needs by shifting to e-bikes and deploying more broadly. Nonetheless, many neighborhoods that could use access to this affordable form of shared mobility remain beyond the reach of

This Machine, mostly due to funding limitations. To equitably expand access to e-bikes and other forms of micromobility, Tulsa needs to work with its public and private partners to re-allocate funding and find new resources to grow This Machine and other micromobility systems. With funding, permitting, and infrastructure policies in place that seek a citywide expansion, micromobility access will be able to grow and be the vanguard for future shared mobility expansions.

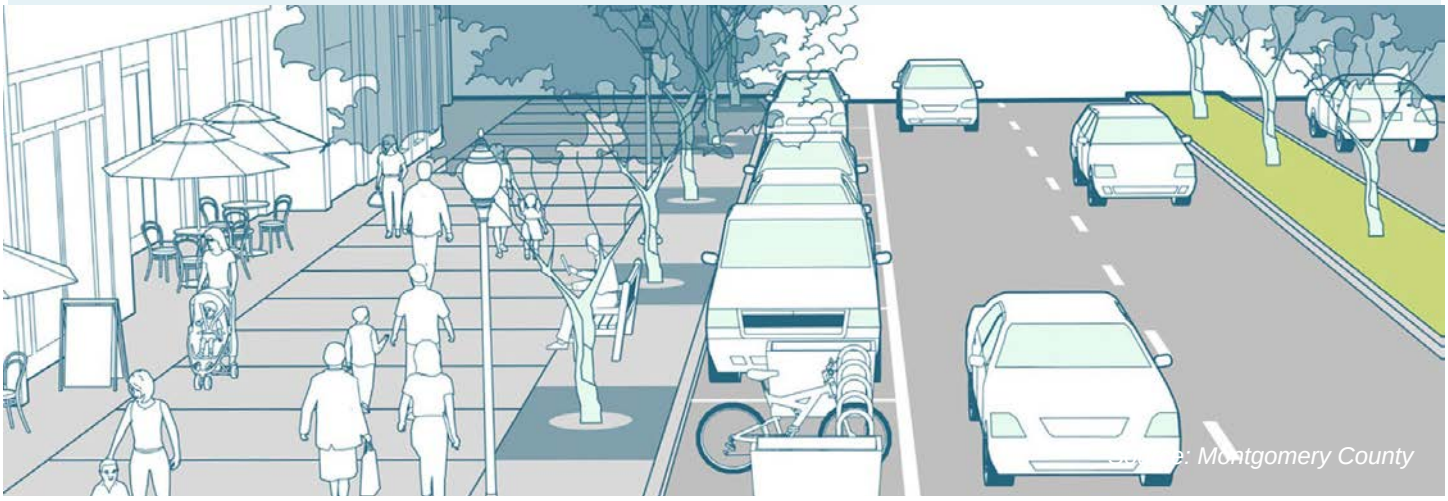
SHORT-TERM ACTIONS

BS16. Launch Walk Safety Assessment

An initial walk safety pilot can expand community and institutional support for expanding walk and micromobility networks.

BS17. Complete Streets Design Guide

Investigate various existing complete streets guides and convene appropriate City staff to complete Tulsa's own guidance, updating or replacing existing auto-oriented street design standards.

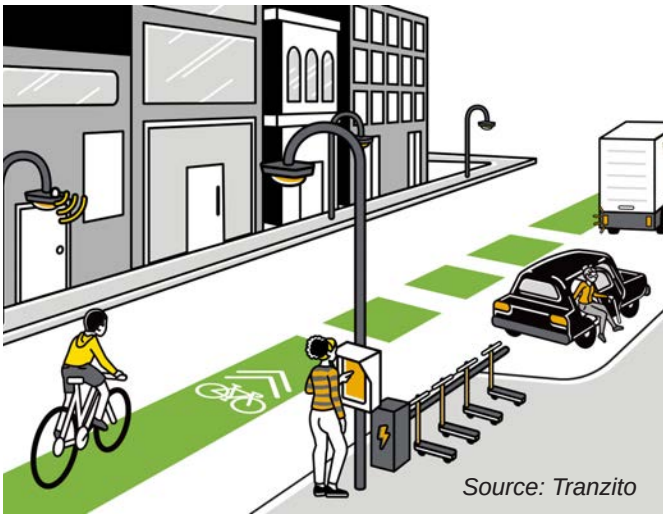


Complete streets design examples like these help visualize the myriad of options for accommodating all modes.

CASE STUDY- Tranzito (Smart City Micromobility Operator)

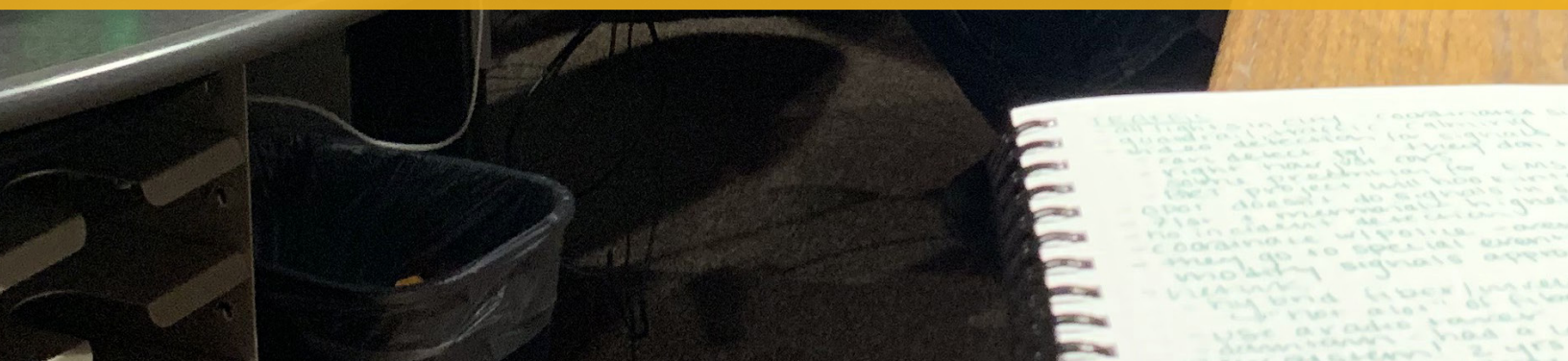
Tranzito provides services to cities and transit agencies by establishing partnerships (with companies like Moovit and Spin) to create multimodal hubs next to existing transit services.

The company's Mobi kiosks are one element of the hubs- providing real-time information, suggested routes, and the ability to book and pay for shared rides (account users) without needing a smartphone.



5. INITIATIVE C: MOBILITY INNOVATION ECONOMY

Expand employment by strengthening the mobility-related jobs ecosystem



INITIATIVE C: MOBILITY INNOVATION ECONOMY

OVERVIEW

Tulsa is already a regional leader in industries such as energy and aerospace. Now, with the rapid growth of new mobility technology, Tulsa can become a leader in attracting, growing, and creating enterprises that produce, implement, and support systems for enhancing mobility, improving freight flows, and increasing efficiency in traditional and emerging sectors of the regional economy. Creating a strong mobility ecosystem is an important opportunity both for expanding technological (tech) employment, as well as for achieving the City's economic development vision.

Walkability and short commutes are valued now more than ever: the National Community and Transportation Preference Survey found that approximately half of millennials and generation Xer's described these characteristics as "very important" in determining where to live.(.15) New mobility options and placemaking improvements can be used to attract new talent and firms to Tulsa where commutes can benefit from emerging mobility solutions by becoming more seamless, informed, and shorter.

These same expanded mobility options would also increase equity among current Tulsans. There are currently nearly three times more jobs in Midtown than in North Tulsa,(16) yet many low-income North Tulsans have difficulty reaching jobs without a car. Over sixty-percent of online survey respondents as part of this MIS effort do not commute by transit because it takes too long, while nearly half do not commute by bicycle due to a lack of cycling infrastructure.

More industry focused on improved mobility options means more jobs in the development, testing, deployment, maintenance, and operations of those emerging technologies, both for new and current job-seekers. In addition to creating jobs, expanding Tulsa's mobility ecosystem would also increase accessibility to current jobs and improve mobility for all Tulsans. Strategies under this initiative also work synergistically with the other initiatives to improve quality of life and equity through innovations, policy, and partnerships.

5.1 EXPAND MOBILITY CHOICES

CHALLENGES AND OPPORTUNITIES

Currently, job centers in the City are not easily reached without a car. Nearly two-thirds of online survey respondents through this MIS effort noted that commuting by transit takes too long, while others reported that distance and lack of facilities were barriers to walking or cycling to work. Employment hubs, such as those along US-169 and the Broken Arrow Expressway, are either not located along transit routes or have infrequent service. Workers today, especially millennials, are seeking alternative commuting options instead of driving.[17] It is therefore in Tulsa's best interest to expand mobility choices to attract and retain talent in the City.

The emergence of new mobility options also provides attractive public realm elements that attract tech employees. As demonstrated in Kendall Square, (Cambridge, Massachusetts) the proliferation of bike share docks, bike racks, transit shelters, separate paths, and public plazas has drawn in workers while reducing traffic, enabling travel lanes to be converted to more biking facilities.

The City has already enacted some initiatives to expand mobility choices. Tulsa's high-quality Aero BRT system provides 15-minute frequencies along the Peoria corridor and connects North Tulsa with downtown and points south, including shopping and amenities. Tulsa Transit has had discussions about public-private-partnerships with employers to provide dedicated commuter services through the Workforce Express Network (WEN). Tulsa's Comprehensive Plan envisions expanding the transit system and creating a multimodal street system to enhance commutes. The City of Tulsa Action and Implementation Management Plan includes strategies to improve access to jobs through improving transit connectivity, encouraging infill development in underdeveloped areas, supporting evolving mobility options, and aligning City processes and policies to support development of affordable and attainable housing. The Mobility Innovation Strategy seeks to build upon these initiatives.

BENEFITS

- **Attract innovation workers**
- **Create testing & innovation environment**
- **Growth without new vehicle trips**

PARTNERS

- **City of Tulsa**
- **INCOG**
- **Private and university campuses**
- **Land developers**
- **Tulsa Authority for Economic Opportunity (TAEO)**
- **Tulsa Regional Chamber**

SAMPLE METRICS

- **Mode shift**
- **Utilization of micromobility devices**
- **Shared mobility pass purchases**
- **Employee satisfaction rates**

FUNDING

- **City of Tulsa**
- **Private businesses**
- **University research**

INNOVATIVE CHOICES FOR WORKERS

Enhancing and expanding shared mobility options will feature the City as an innovation hub, while also providing services to benefit current and future residents. New services can be touted in City, Downtown Tulsa Partnership, and Chamber of Commerce talent-attraction strategies and initiatives. The City should begin by focusing on its downtown innovation district as a pilot area to expand shared mobility options, adding microtransit, automated transit, new micromobility devices, and other shared ride platforms to the current mix of e-scooters and shared bikes. Outside of downtown, the City can revisit its site plan review standards to incentivize the funding or creation of new last-mile connections to transit. Mobility innovation can also be incorporated into economic development incentive programs by including the City's innovation districts such as the Sixth Street Corridor Opportunity Zone into tax incentive programs that reward the creation of new shared mobility infrastructure, including docks, lanes, shelters, and charging stations.

C1. FOSTER MICROMOBILITY

Micromobility services should be fostered in a way to incentivize their spread seamlessly throughout the city. Zoning and building codes should be changed in order to allow micromobility amenities and memberships to be substituted for required parking. Harmonious integration with other modes can be ensured through policies such as requiring off-street space for micromobility docks that do not remove valuable sidewalk or road space.

C2. CREATE SAFE SPACES TO WALK AND BIKE

People will not walk, bike, or use micromobility options if they do not have safe spaces in which to do so. The City should complement the expansion of mobility options with strategies to implement policies and infrastructure that promote safety when not using a car. The City can prioritize the importance of walkability and bikeability through the reprioritization of roadway funding, advancement of non-auto infrastructure, and promotion of new safety technologies. Site plan review guidance for cycling, walking, micromobility, and transit amenities should be developed to ensure that these issues are at the forefront as the city grows.

This rendering reimagines a street in Tulsa as a hub that links all available modes and provides people with transportation options to best meet their needs.

CASE STUDY-
Detroit, MI
Shared Mobility

Source: Shared Use Mobility Center

To complement limited late-night bus service, the "Woodward 2 Work" pilot program covers up to $7 on weekday Lyft rides traveling to and from bus stops along the 53 Woodward route from midnight to 5 a.m. The program is a partnership between the Detroit Department of Transportation and Lyft and helps workers travel to and from their jobs outside of transit operating hours.

SHORT-TERM ACTIONS

CS1. Convene Discussions Between Tulsa Transit and Employers

Tulsa Transit should continue discussions with employers to coordinate commuter services that encourage alternatives to single-occupancy vehicles.

CS2. Review Market and Statutory Issues

The City should review current market and statutory issues to better understand needs, trends, and constraints facing employers and emerging technology developers.

CS3. Design an Adaptable Incentive Policy

An incentive policy should encourage placemaking and new mobility options in all new municipal projects and private developments, with regular policy updates that adapt to changing technologies and preferences.

CASE STUDY-
Safe Streets Long Beach, CA

Safe Streets Long Beach is a Vision Zero project that is supported by a plan released in July 2020 which aims to eliminate traffic-related fatalities and serious injuries by 2026. Keystone Actions intended to fast-track long-term changes, include:

- Lowering Vehicle Speeds
- Implementing Best Practice Street Design
- Expand the Multimodal Safety Education Campaign
- Collecting Better Data to Make Better Decisions

The overall effort is supported by a comprehensive and engaging website for both practitioners and the general public.

5.2 DEEPEN TALENT POOL

CHALLENGES AND OPPORTUNITIES

Before Tulsa can become a regional leader in the mobility technology field, it must be able to attract and retain the necessary talent that firms need. As detailed in Appendix C- Economic Assessment, Tulsa currently has some workforce gaps in certain skills, as well as supply chain components that are necessary for mobility technology firms, such as engineering and manufacturing instrumentation. Additionally, the City has challenges retaining the talent that comes out of its universities and training programs. Tulsa's post-secondary education system is an asset that can be built upon to provide the right preparation, but it will be necessary to attract firms that welcome and retain this talent while also attracting new workers.

Several initiatives in Tulsa have been working to deepen the City's talent pool. The Tulsa Remote program has garnered national attention for offering remote workers $10,000 to relocate to the City. The City of Tulsa Action and Implementation Management Plan contains strategies around education and growing the workforce, including offering student internships and job shadowing. TYPROS, the City's young professional organization, focuses on attracting and retaining young creative talent in Tulsa. The recently opened Holberton School campus in Tulsa will provide a tuition-deferred college alternative for training software engineers.

BENEFITS

- **Increase economic development**
- **Retain talent**
- **Attract new talent and firms**
- **Build prestige of Tulsa's universities**

PARTNERS

- **Universities**
- **Major employers**
- **City of Tulsa Office of Economic Development**
- **TYPROS**

SAMPLE METRICS

- **Improved access to jobs/ education**
- **Increase in number of mobility-related internships/ externships filled by university students**
- **Increase in number of academic/training programs in key fields**
- **Increase in net in-migration**

FUNDING

- **City of Tulsa**
- **Local universities**

INNOVATIVE TALENT STRATEGIES

Tulsa can deepen its talent pool to attract mobility technology firms and investments. The following strategies focus on training and partnerships in key industry areas.

C3. PROVIDE MOBILITY SERVICES TO COLLEGES

Tulsa's academic institutions can build relationships across universities and with local innovation hubs through enhanced travel connections that make internships and idea-sharing easier for students and researchers. For example, an east-to-west BRT line along the Route 66 corridor could facilitate partnerships between the University of Tulsa and local companies. Such opportunities would attract new students from outside the region to local universities and funnel them into local job opportunities upon graduation.

C4. PARTNER WITH UNIVERSITIES AND COLLEGES TO BUILD OUT TECHNICAL SKILLS PROGRAMS

Tulsa can ensure that its talent needs are met by fostering partnerships with higher education to build out technical skills programs. Such programs should provide rapid training of workers in key areas that are currently experiencing skills shortages, such as industrial processes and software development. Strategic partnerships should be considered with academic programs, existing university research centers, and local economic development groups. The existing retail entrepreneur development programs should also be extended to mobility innovation and technology. Walking, micromobility, and transit amenities should be developed to ensure that these issues are at the forefront as the City grows.

C5. FILL GAPS IN LOCAL SUPPLY CHAIN COMPONENTS FOR KEY INDUSTRIES

Aside from training workers, Tulsa should work to attract people and firms with critical roles in key gap industries. The City should develop a list of potential regional sources of suppliers, as well as an attraction strategy to build a support cluster of firms developing, for instance, manufacturing process instruments, advanced motors, and search and navigation instruments. Tulsa should foster talent pipelines and attraction programs to improve its supply of workers in key areas, such as engineers and technical consultants.

CASE STUDY- Atlanta, GA Talent Attraction Program

Atlanta's Choose ATL program attracts new talent to the city by highlighting the city's amenities, including mobility.

Its website offers neighborhood profiles,company highlights, and information about the city's culture.

WEST MIDTOWN

Once largely an industrial district, West Midtown now offers some of the best art galleries, live music venues, and innovative restaurants in Atlanta. The location is quickly growing with new loft apartments and neighborhoods in Berkeley Park or Hills Park. Known as the premiere location for high-tech companies and upstart Atlanta businesses, the area offers easy commutes to work or a short Uber ride for a night out.

Source: IC Bus Manufacturing

Tulsa's strong manufacturing operations could be strategically expanded to attract and serve other industries.

CS4. Maintain Scooter Presence
Maintain and encourage e-scooter and bike share presence on university campuses and in downtown.

CS5. Continue Inter-Campus Bus Service
Continue bus service connecting Oklahoma State University with University of Tulsa.

CS6. Connect Campuses with Opportunities
Connect university campuses to innovation zones by transit or shuttle to facilitate mobility learning laboratories.

CS7. Facilitate Partnerships for Student Training
Encourage and facilitate partnership arrangements between universities, local companies, and the City to create a reliable stream of relevant internship and externship opportunities.

CS8. Plan for an Innovation Accelerator
Begin preparatory planning for an accelerator that aligns universities with venture capital interests in automation and clean energy. This includes considerations around funding, location(s), outsourcing/ internal skills, and incentivizing competition.

E-scooters provide an ideal travel solution for university students needing to make short trips.

5.3 ATTRACT AND DEVELOP NEW TECH FIRMS

CHALLENGES AND OPPORTUNITIES

Tulsa already has educational and industrial assets in place related to its current economic strengths, including aerospace, advanced manufacturing, and energy. Aside from talent gaps discussed in Section 5.2, Tulsa must also fill local supply chain gaps to strengthen its appeal to new firms. The gaps in supply chains must be filled to better position Tulsa to attract mobility technology firms. The primary industries targeted are: advanced industrial processes, manufacturing instrumentation, and search and navigation equipment.

The City has already begun to establish its tech niche and attract new industries. Tulsa Innovation Labs, a coalition of public and private partners, is developing a city-wide strategy to position the City as a tech hub and industry leader in areas that include energy, cybersecurity, and analytics. The University of Tulsa is leading the creation of a Cyber District allowing industry, Federal agencies, and the University to collaborate on cybersecurity. Tulsa is already positioning itself as a hub for drone testing through Skyway36, the Osage Nation's technology innovation zone, four miles north of Downtown. An opportunity exists to leverage these efforts and Tulsa's existing assets to aid the recruitment of new firms in the field of mobility technology.

BENEFITS

- Increase economic development
- Create new jobs

PARTNERS

- City of Tulsa Office of Economic Development
- Tulsa Port of Catoosa
- Tulsa Airport
- Tulsa Authority for Economic Opportunity (TAEO)
- Tulsa Regional Chamber

SAMPLE METRICS

- Number of technology employers
- Number of technology jobs
- Percentage of workforce in technology

FUNDING

- Innovation to Enterprise
- Tulsa Economic Development Corporation
- Creative Oklahoma
- Venture capital firms

INNOVATIVE EMPLOYER STRATEGIES

Modest investments to create and foster interactive centers or districts of innovation can payback large dividends by rapidly attracting targeted pools of talent. Tulsa's gaps in mobility technology related skills and supply chains can be surmounted by leveraging existing economic development efforts in the region.

C6. CREATE MOBILITY INNOVATION CENTERS ON CYBERSECURITY, AV FREIGHT, AND LOGISTICS

Demonstration projects showing regional capabilities to support emerging businesses focused on mobility innovation will attract the attention of target firms. In line with the Tulsa Innovation Labs priorities, the City should create mobility innovation centers in which it can demonstrate its current assets in fields such as cybersecurity, AV freight, and logistics to attract new industries that fill identified gaps. This should be done in partnership with academic institutions and private entities to ensure the right gaps are targeted jointly. To start this process, the Mayor's office can designate a staff person to facilitate interest from transportation technology firms. Currently, there is not a single point of contact for firms who are interested in testing or partnering with the City. A first action step is to streamline this process for the City.

C7. DEVELOP A CYBER DISTRICT

Creation of cyber districts, such as the one spearheaded by the University of Tulsa, could support new and existing businesses in mobility technology fields. Similar to the Sixth Street Opportunity Zone corridor, Federal tax incentives could be used to encourage development in other parts of the city focusing on AVs, energy technology, and other emerging fields. Walking, micromobility, and transit amenities should be developed to ensure that these issues are at the forefront as the City grows.

The Sixth Street Opportunity Zone (Cyber District) proposed by the University of Tulsa.

C8. CREATE MULTIMODAL TEST BEDS FOR AV FREIGHT, RIVER, AND UNMANNED AERIAL SYSTEMS

Existing manufacturers of automotive electric vehicle engines and components are embedded in their host communities, taking advantage of local skills, infrastructure, and amenities. This points to the need for Tulsa's business recruitment and development strategies to highlight the local advantages for designing, testing, and manufacturing non-automotive electric vehicles, including air, marine, robotics, and farm equipment. The City should take advantage of existing assets such as the Port of Catoosa, Skyway36, and Tulsa International Airport to develop test beds for these emerging technologies. Demonstration projects showcasing Tulsa's capacities could attract other firms in these industries.

Tulsa International Airport

Tulsa Port of Catoosa

CASE STUDY- The City of Austin, TX

The City of Austin has attracted tech firms due to its business-friendly atmosphere and city culture. Tech firms that have moved to Austin cite the City's support for incubating startups and existing tech talent as attractive qualities. Additionally, the Chamber of Commerce and other organizations provide support to companies relocating to Austin.

Source: Business Insider

SHORT-TERM ACTIONS

CS9. Create Form-Based Land Development Codes
Rewriting zoning codes to be form-based allows the flexibility and creativity needed for designers and manufacturers of emerging mobility devices to innovate from small, flexible, or other non-traditional spaces across the city.

CS10. Create Tax-Increment Financing (TIF) Districts
TIF districts or improvement districts in innovation districts and port areas can help finance needed mobility investments that attract skilled workers.

CS11. Review Port Management Structure
Review management structures to ensure that administration and planning functions at ports and targeted innovation districts are more proactive and nimble about attracting new firms and talent.

CS12. Update Economic Development Marketing Plan and Recruitment Materials
Tulsa should develop an "open for mobility innovation" marketing plan to attract firms. Recruitment materials should include land use and mobility changes that attract talent and promote economic development. Particularly highlight new innovation and improvement districts.

6. INITIATIVE D: MOBILITY INNOVATION AND PARTNERSHIP

Build lasting mobility solutions through lasting mobility partnerships

INITIATIVE D: MOBILITY INNOVATION AND PARTNERSHIP

OVERVIEW

Progress in mobility innovation depends on proving, scaling, and integrating a variety of digital, vehicle, and fueling technologies into the transportation system. Success depends less on significant technology breakthroughs and more on an environment that brings together innovative transportation expertise with the “proving grounds” to test and apply new technologies. Proving grounds for emerging transportation solutions include real-world places like streets, sidewalks, and airways, as well as digital infrastructure placed in or communicating with those solutions and the places they operate within. This breadth of infrastructure demands expertise and users from a range of disciplines that often do not traditionally converge. When the users, experts, and developers are not working together, there is often a mismatch between the solutions presented and the actual needs. Building partnerships across these parties can align user wants and needs with more effective solutions.

The City can catalyze partnerships amongst the business community, investors, technology nonprofits, and universities, working as a convener, first customer, and valuable leader in identifying financial and in-kind support. Tulsa is rich in venues and proving grounds for creating and deploying emerging technology solutions that can ease congestion, bolster retail, improve safety, and expand and diversify the local economy. These include places such as: downtown, with its combination of office, retail, residential, and entertainment locales; the new drone testing facilities near Osage Nation lands; Tulsa International Airport; Tulsa’s inland river port; and multiple local universities with cybersecurity and computer science programs. Tulsa is also rich in university research programs and is witnessing an expansion of incubators and accelerators that foster entrepreneurs and bring ideas to market. By embracing pilot programs conducted in partnership with a range of stakeholders, then adding the right mix of user groups, investments, and business capacity, Tulsa stands to become a leader in mobility solutions and a magnet for innovators in the development and operations of these emerging technologies.

6.1 BRING INNOVATION TO DOWNTOWN STREETS

CHALLENGES AND OPPORTUNITIES

Downtown Tulsa is central to a citywide Mobility Innovation Strategy with respect to promoting a vibrant economic zone that supports accessible, active, automated, and electric transportation as well as all forms of shared transportation, from bikes and scooters to shared rides, shared cars, microtransit, and automated transit and freight. Downtown Tulsa faces challenges that existed before the COVID-19 pandemic and are compounded further by both accelerated e-commerce and heightened requirements for safe, shared transportation. A number of these challenges and opportunities are highlighted as follows:

- Though the new City parklet program allows for expanded outdoor dining, the curb space is crowded. Parking spaces have been reallocated for pick-up and drop-off for offices and restaurants. Delivery vehicles double-park, blocking travel and bike lanes. It is often difficult to access businesses or to find a spot to stop for a quick errand. However, these crowded curbsides and fleet partners offer an opportunity to trial solutions for managing deliveries along with pick-ups and drop-offs that will let businesses connect with suppliers and customers while riders connect with transit and shared rides.

- E-scooters provide both a commuting and recreational travel option, yet they often dash unnervingly close to pedestrians on the Center of the Universe bridge and then are frequently left to block sidewalks and curbs. Fortunately, since each e-scooter is equipped with real-time location tracking, developing an understanding of how scooter traffic flows can offer the opportunity to explore how to create safe and pleasant travel paths for all. This same insight on busy corridors or on university campuses can lead to future solutions that reduce congestion, increase safety, and improve the delivery of these popular mobility services.

- While expanded bike lanes are beginning to connect downtown to other parts of the city, access to shared bikes, bike storage, and e-bikes is limited. To attract the needed investment in a citywide mobility ecosystem requires both expanding mobility and creating a strong sense of place.

BENEFITS

- **Deploy solutions faster**
- **Maximize visibility of innovations**
- **Accelerate procurement & funding**

PARTNERS

- **City of Tulsa**
- **Downtown BID**
- **Major employers**
- **Technology vendors**

SAMPLE METRICS

- **Pilots and demonstrations per year**
- **Miles traveled by smart mobility solutions**

FUNDING

- **Downtown BID members**
- **Major employers**
- **Universities**
- **Technology vendors**

- In order to thrive, emerging new mobility options such as automated shuttles or e-bikes require partner support as well as a critical mass of users. However, Tulsa's Inner Dispersal Loop (IDL) separates downtown from adjacent neighborhoods, especially Greenwood where the highway is an elevated viaduct. Poor walking and biking connections across this barrier will limit the potential of smart mobility without a concerted effort to make needed improvements to the viaduct's pedestrian environment.

- Developing areas for people so they can live, work, and play with access to a range of mobility choices is integral to attracting and retaining talent vital to the economic prosperity of Tulsa's neighborhoods. Plans to redevelop the plaza at the Center of the Universe bridge is a chance to learn how to tweak urban design to create a vital space that connects the business core with the Arts District.

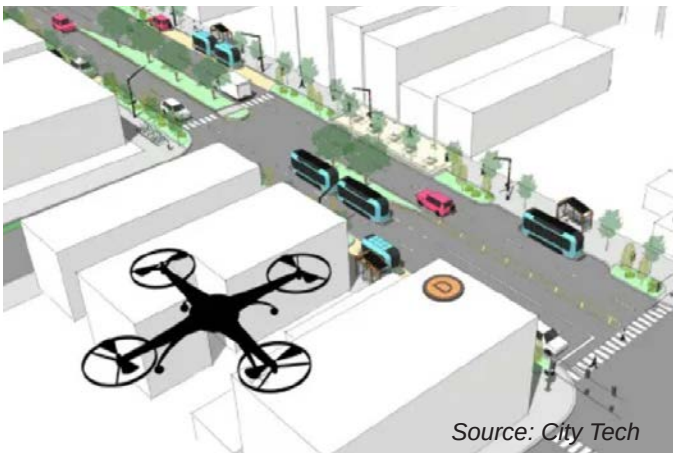
Many recent activities support strengthening the evolution of mobility innovation in Tulsa. The City recently spun off the Downtown Commission into a new Business Investment District (Downtown Tulsa Partnership) and has taken key steps to expand access to downtown with Bus Rapid Transit (BRT). The new Peoria Avenue BRT line connects Tulsans to downtown jobs with 15-minute headways on a North-South corridor. During the summer of 2020, Tulsa launched a new express bus service on an East-West axis. This Machine's shared e-bikes are expanding beyond downtown into adjacent neighborhoods, and plans are underway to create a walkable path across the highway. The City has just secured an agreement for a new grocery store at Pine and Peoria, and has begun partnering with businesses to bring parklets to life in key areas.

CASE STUDY- Chicago Streets of the Future Project/City Tech Collaborative

In 2019, City Tech invited subject-matter experts to provide input on current demands in transportation, emerging trends, and how they can be factored into future design and operations.

A set of both performance and physical street requirements were identified as necessary for Chicago to be future-ready (10-30 years). Technology-supported and flexible design prototypes were modeled for typical Chicago streets with strategies that could be deployed elsewhere in the city, such as:

- Adding microbuses to existing transit fleets
- Establishing pick-up and drop-off zones for rideshare and deliveries
- Enhancing digital infrastructure
- Designating micromobility zones
- Utilizing drones for parcel delivery



Source: City Tech

INNOVATION LABORATORY STRATEGIES

In partnership with the Downtown Tulsa Partnership, the City would create a Mobility Innovation Lab —a public-private-nonprofit partnership. The Mobility Innovation Lab would convert this district downtown into an incubator for innovation, economic development, equity, and environmental considerations. The streets and highways, curbs and sidewalks, transitways, and bikeways would serve as the proving ground for technology, planning, and policy solutions leveraging next generation mobility solutions to expedite the realization of equity, environmental, and economic development goals when scaled to other parts of the City.

The Mobility Innovation Lab's program of pilots will focus on challenges in downtown such as curbside management, expanding shared mobility, improving transit access, and connecting pathways for safe walking and biking between neighborhoods across downtown. Other near-term and midterm opportunities include addressing mobility in the downtown during the workday through an electric shuttle, and showcasing AV technology with a downtown pilot. The Downtown Tulsa Partnership's support for pilots for mobility technologies that generate shared revenues can lead to new funding sources for other transportation and infrastructure programs. The Mobility Innovation Lab could advance placemaking priorities and be integral to efforts to attract talent and new investment in downtown.

The following are possible projects for assessment by the Mobility Innovation Lab.

D1. PIONEER DIGITAL ASSESSMENTS OF THE STREET, CURBSIDE, AND SIDEWALKS

Using sensors and counting devices, digital assessments understand how drivers, bikers, scooter riders, and walkers use sidewalks and roadways to reveal insights that save lives and money as well as make access more convenient. The Downtown Tulsa Partnership could lay the groundwork for a more walkable and bikeable community in downtown and the adjacent Greenwood neighborhood by analyzing movements of specific blocks and corridors, gathering anonymous movement data without compromising an individual's privacy. A real-time movement dashboard of pedestrians, bicyclists, people on scooters, cars, and trucks would also allow the City to understand travel patterns better. With an understanding of downtown in hand, the pilot can be redeployed in other specific locations or along corridors across the city.

D2. ALLEVIATE CURBSIDE CONGESTION WITH SMART ZONES

A pilot of smart zones would allow the Mobility Innovation lab to understand the value of new technology in order to address crowded curbs that impede the free flow of traffic as well as access to restaurants, retail, and other business. Smart zones would be marked by signs, and drivers would use a mobile app to see real-time smart zone locations and availability. Drivers could then hold spaces by booking time in a smart zone. Fees to use a smart zone are shared revenue for the vendor and the City.

D3. PILOT MICROMOBILITY HUBS WITH ELECTRIC CHARGING CAPABILITIES

Shared bikes and e-bikes are currently available downtown, and e-scooters may be availalble in the near future. The new GoPass app even includes Spin scooters as a travel option that can be paid for and booked in the same way that one secures a ride on BRT or regular bus service. Micromobility hubs that provide charging for e-bikes and e-scooters could be piloted to provide a safe and unobstructive place to store these

devices while not in use. The micromobility pilot should be evaluated for its ability to generate revenue, reduce operating costs, and become an amenity for property owners.

D4. JOIN WITH TULSA TRANSIT, CAMPUS TRANSPORTATION, AND ENTERTAINMENT VENUES IN PILOTING AN AV SHUTTLE PILOT IN MULTIPLE OPERATING ENVIRONMENTS

AV shuttle pilots over a range of use cases can fill gaps in mobility services and potentially extend the catchment area of Tulsa's transit system. The downtown area could be a proving ground for safety-related technologies, AV shuttles, and other types of automated mobility systems. The deployment of a vehicle or fleet of shuttles could facilitate university-led research on customer acceptance, cybersecurity, and other considerations. Any pilot should work to address identified mobility needs in Tulsa.

D5. PILOT FIRST AND LAST-MILE FREIGHT DELIVERY

Small electric vehicles provide opportunities for the delivery of food, medical supplies, and small packages. These might be automated ground robots, aerial drones, or unmanned vehicles. Piloting these technologies could establish proof-of-concept, refine operating strategies, and inform infrastructure requirements. Pilots might also feature business models that generate revenue for local businesses and reduce costs for social service agencies. Deployments in identified areas of need, such as healthy food deserts, should be prioritized.

A vision of how AV shuttles could seamlessly communicate with other modes and potential users.

SHORT-TERM ACTIONS

DS1. Create Public-Private Partnership Structure

A memorandum of understanding (MOU) between the City of Tulsa, INCOG, and the Downtown Tulsa Partnership would establish the vision and parameters for the Mobility Innovation Lab. The MOU would identify the roles of the partners, identify proposed venues, outline a vetting process for pilots, and delineate a process for monitoring and evaluating selected pilots. The MOU would call out cooperative efforts with proximate economic development efforts, as well as with local partners and universities.

DS2. Conduct an Environmental Scan of Mobility Innovation Pilot Opportunities

As an evolving center for mobility innovation, Tulsa can attract talent and ensure pilot projects remain relevant by conducting a regular scan of emerging transportation technologies and potential pilot deployments available in the industry or deployed elsewhere. Thanks to multiple non-profits and safety advocacy organizations, there is a rapidly growing body of research that a dedicated researcher at the City, INCOG, or the Downtown Tulsa Partnership could summarize for Tulsa's benefit.

DS3. Initiate Pilot of Mobility Data Assessment for Road and Sidewalk Safety

The City, in partnership with INCOG, could assess pedestrian and e-scooter travel patterns in the area of the "Center of the Universe" over a six-month time period, testing sensors and validating data with field observations. This pilot would build on efforts in peer cities and would be developed in a manner that could validate technologies and be replicated in other hot spots and corridors across the region. Funding sources might include Congestion Mitigation and Air Quality Funds, Advanced Innovation Development grants, technical assistant and research grants from the Federal Transit Administration, and the US Department of Transportation's cooperative research programs.

DS4. Convene Stakeholders for Technology Workshop Pilots on Automated Mobility and Freight

Level-setting an understanding of emerging technologies, their transportation use cases, and the ways to pilot automated vehicles for the movement of goods or people is a critical initial step to charting Tulsa's AV future. To date, the City has become a leader in understanding how cities are preparing for autonomy, exploring opportunities to use autonomous transportation for the delivery of essential goods, and in understanding what other use cases align with Citywide transportation, land use, and economic development interests. A technology workshop would help get stakeholders current on technology and policy, as well as help forge the partnerships required to fund and operate AV deployments in the City. Stakeholders include investors, vehicle vendors, EV vehicle and charging vendors, landowners and property managers, economic development agencies, City departments, Tulsa Transit, community representatives, and others.

DS5. Identify Philanthropic and Private Sector Funding Opportunities

Besides Federal funding opportunities which have limitations and may be competitive, Tulsa could seek philanthropic and private sector support for pilots and deployments. Both local and national foundations which share similar equity, innovation, and economic development goals can be approached to support mobility solutions, especially university-related research foundations seeking real-world testing data. Private manufacturers, vendors, and developers also can contribute funding to pilots which test their solutions on public rights-of-way or contribute to reduced land development costs.

6.2 BUILDING MOBILITY INNOVATION SOLUTIONS

CHALLENGES AND OPPORTUNITIES

The Greater Tulsa area is home to research universities, businesses and investors focused on improving the environment, economy, equity, and business incubators and accelerators. Tulsa is served by an airport, inland port, interstate trucking facilities, a one-of-a-kind unmanned flight testing center (currently in development), and new residential communities, each of which today provides an important campus environment supporting new automated, connected, electric, and shared mobility systems. The City is home to two key plays to electrify personal cars and heavy vehicles. All of these ingredients provide a unique opportunity to create a regional ecosystem that supports innovative mobility solutions, if they can be effectively coordinated. The opportunities and challenges include:

- Nascent mobility technologies need physical and digital venues in which to operate and be monitored. Tulsa's downtown and several campus-like environments provide these semi-contained opportunities.
- The Center of Middle Mile and Long Haul freight and Logistics provides a nearby resource for connecting over-the-road freight to automated delivery pilots in Tulsa.
- Tulsa has already deployed an extensive vehicle charging network by various vendors that can power innovative mobility devices.
- There are at least six local incubators or accelerators that can add focus on mobility investments and workforce training.
- Emerging public and private innovation interests are ripe to expand investment in mobility solutions.

BENEFITS

- **Capitalize on recent successes to spur innovation**
- **Inspire Tulsa's innovation economy**
- **Create partnerships for future mobility innovations**

PARTNERS

- **Surface transportation agencies**
- **The Tulsa Port of Catoosa**
- **Tulsa International Airport**
- **Private and university campuses**
- **Private technology vendors**
- **City of Tulsa**
- **INCOG**

SAMPLE METRICS

- **Number of member organizations**
- **Number of deployments**
- **Annual dollars leveraged from outside Tulsa**

FUNDING

- **Federal grants**
- **National foundations**
- **FHWA congestion & highway programs**
- **State Innovation Grant**
- **City of Tulsa**
- **Private technology vendors**

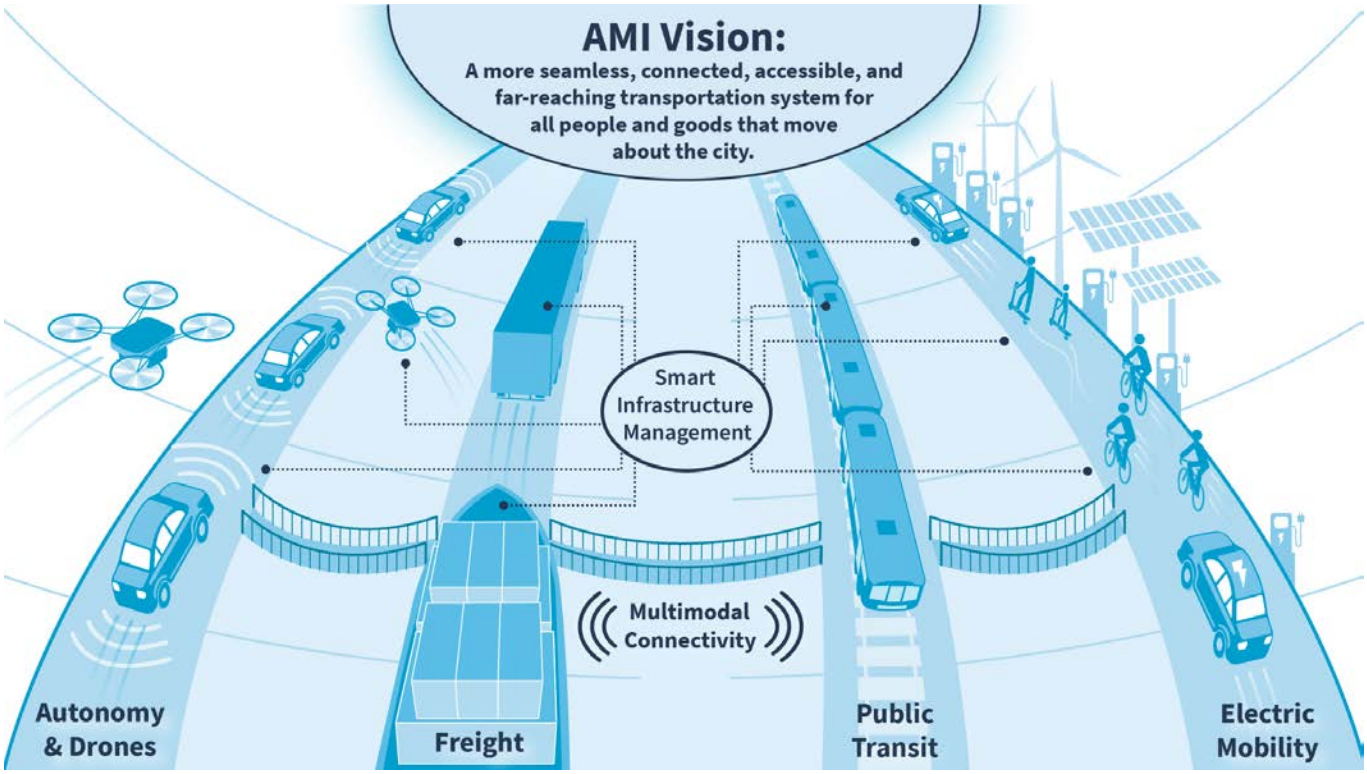
INNOVATION PARTNERSHIP STRATEGY

Multiple opportunities for fostering a mobility innovation economy in greater Tulsa exist. However, the breadth of public and private innovators rarely have the mandate or funding to work together. Building a partner network can avoid duplication, accelerate innovation, and identify new local opportunities to harness.

D6. CREATE PARTNERSHIP NETWORK TO CONVERT CAMPUSES AND CORRIDORS TO ENGINES OF INNOVATION

A "4P" network of public, private, and philanthropic partnerships in Greater Tulsa would be integral to creating an innovation ecosystem that would foster the development of mobility innovation solutions and attract investment in mobility technology. The network would build from existing strengths in electric vehicles and charging infrastructure, local investment in (and support for) start-ups, and nearby venues that are well-suited for piloting of automated and connected mobility for passengers and freight. The university programs located in Tulsa provide a key link in the network of talent development and research expertise needed to move the needle on new modes and technologies. The targeted technologies include automation, data analytics, and electrification, as well as software and MaaS required in each area. With regional expertise in cybersecurity, and with a range of venues for testing, the 4P network would be a catalyst for safe and sustainable deployment of next generation transportation technology.

At the heart of successful innovation is an ability to connect with user groups who will rely on the technologies and operating environments. Building on models like the City-Tech Collaborative, the Riverside Innovation Corridor in California, the Ulupono Initiative in Hawaii, and the Center for Environment and Transportation, the



The goal of City Tech's Advanced Mobility Initiative (AMI) Roadmap is to engage the city, residents, and thought leaders in developing collaborative mobility solutions that link all modes.

City is well-positioned to bring forward a partnership that will foster mobility solutions for Tulsa. Led by the City, in coordination with INCOG, a 4P network would focus on vehicle and device development and associated supporting components of shared mobility systems. The network would knit together the region's existing incubators and accelerators, venture capitalist and family foundations, fleet owners and manufacturers, research and educational institutions, and transportation facility owners into an innovation ecosystem. Such an ecosystem is key to fostering local start-ups, as well as attracting technology and knowledge workers and new investment. Potential focus areas for the 4P network initiatives include:

- Tulsa's international airport is an ideal medium-sized proving ground for airborne automated solutions, providing a venue for proof-of-concept of a full range of aviation-related smart logistics, transportation, security, maintenance, and cleaning solutions.
- Tulsa's river port is an attractive incubator venue for testing of smart and electrified freight and logistics solutions, including automated drayage, crane, sorting, forklift, and other similar tools.
- The Osage Nation is building a facility for the testing of UAVs and related systems for commercial and civil use. A 4P network could support recruitment of technology firms in the U.S. and globally. An expansion of this work might include a partnership with Tulsa International Airport to support sustainable business models that meet package delivery, organ transplant, and emergency response requirements.

Other potential focus areas include:

- Cybersecurity Resilience (a partnership between universities and mobility providers modeled on the Virginia Tech Transportation Institute)
- Testbed for Electric Heavy Vehicle and/or Small Electric Vehicles (building off of Electric School Production and perhaps in partnership with Osage Nation)

CASE STUDY- Hawaii Technology Development Corporation (HTDC)

HTDC offers a series of solutions to build next generation technology and industries. Their **80/80 Initiative** targets creating 80,000 new tech and innovation jobs earning $80,000 or more by 2030.

The **INNOVATE Hawaii** program offers training, consulting, grants, and collaboration-focused industry programs to manufacturers that are willing to invest time and resources to grow their company.

The **Entrepeneurs Sandbox** is a community center facility providing rentable meeting spaces, co-working spaces, offices, and a digital media studio to local innovators.

All-age educational programs and activities are also hosted.

Drone testing at the Skyway36 Airpark site near Osage Casino.

SHORT-TERM ACTIONS

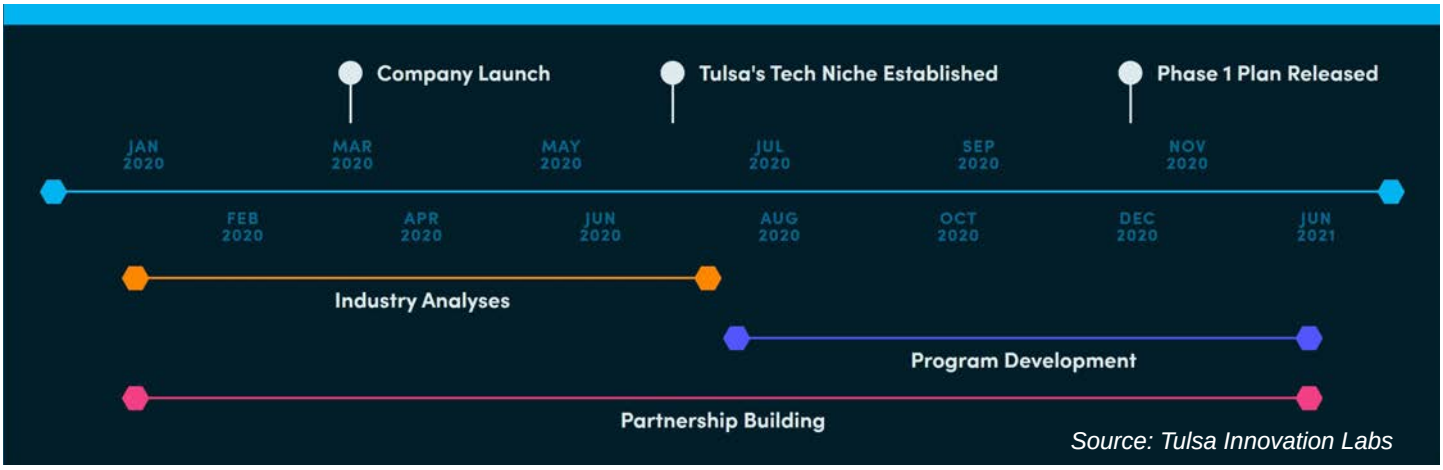
DS6. Coordinate Early Stage Partnerships
Under the auspices of the Innovation Director, identify early wins in robotics, including air drone testing and proof-of-concept pilots based on simulation or live deployments. Recruitment strategies would include provision of data for simulation, capture of data for proof-of-concept or pilot sponsors, and development of incubator support through Tulsa's Innovation Lab.

DS7. Create an Advisory Committee
Under the leadership of the Innovation Office and in collaboration with the Tulsa Authority for Economic Opportunity, a new advisory committee would be charged with creating a charter, prioritizing implementation of project areas, developing a 12-month action plan for a 4P network, and identifying members of the network.

DS8. Develop Year-One Implementation Plan
Key activities would be developing priority problem statements, aligning technologies with regional partners, creating an innovation challenge, and launching one 4P project.

DS9. Identify Funding Opportunities
Develop a resource index of governmental funding sources, including pandemic relief, stimulus, and vehicle technology research innovation funding from Federal sources. This virtual resource center would also include resources for technical assistance, non-governmental partners, and best-practices for innovative funding/financing of mobility projects.

DS10. Grocery Mobility Hub Pilot
Create a grocery store mobility hub partnership of City and other public agencies, property owners and retail stores, transportation providers and technologies, and philanthropic interests to create a mobility hub built around a grocery story. Public agencies should include transportation, infrastructure managers, planning agencies, and economic development and human services organizations. Local universities may be tapped for monitoring and evaluation and/or technical assistance.



Tulsa Innovation Lab's approach for a shared vision between partners.

7. PRACTITIONER CHECKLISTS

Outlining early action steps for key mobility innovations

PRACTITIONER CHECKLIST

GROCERY STORE MOBILITY HUB

WHAT IS IT?

A designated, publicized, grocery store **mobility hub with multiple transportation options for people of all ages, income levels and abilities**. The hub integrates shared mobility for people travelling to stores as well as multiple delivery options.

WHAT DOES IT ACCOMPLISH?

The grocery mobility hub **corrects the spatial mismatch** between neighborhoods with poor access to fresh food and grocery stores that have traditionally been "out of reach" due to lack of convenient, safe, affordable travel options. Secondarily, it can serve resilience needs as a drop-off and pick-up point for essential supplies during societal shocks and stressors such as climate events and the current pandemic.

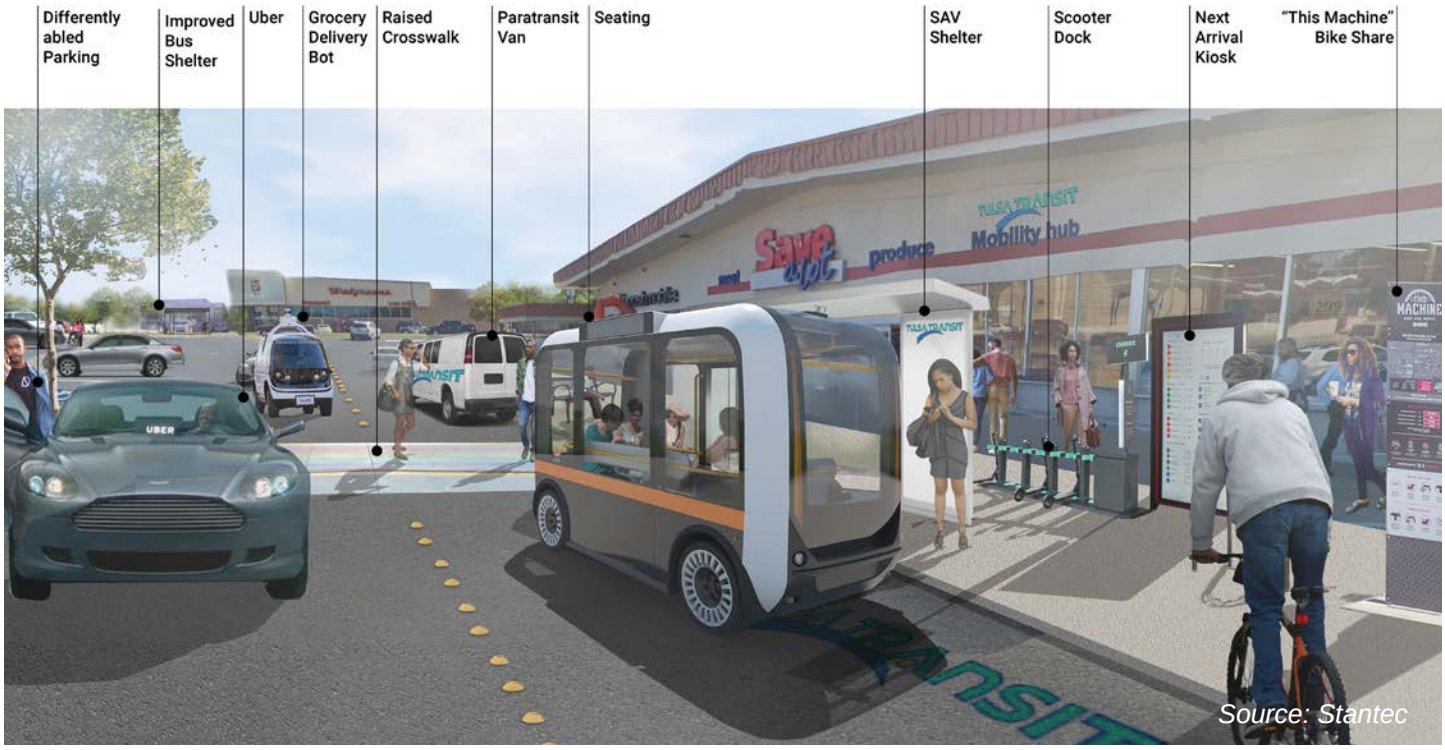
KEY INGREDIENTS

- Success factors for sustainable business models
- Key partners to be engaged
- Policies or plans required to succeed
- Funding strategies
- "Case studies" in a similar community
- Use cases/technology matches

LOCATIONS

Grocery stores in neighborhoods with higher concentration of below-median household incomes, in a **recognized food desert**, and potentially with proximity to 30-minute headway bus service.

Potential Pilot Location: PROJECT OASIS



Concept rendering of potential grocery store mobility hub.

EARLY ACTIONS

- Designate preferred locations such as Project Oasis
- Begin with a pilot project incorporating tactical urbanism elements such as temporary painted crosswalks, jersey barriers, and signage

PARTNERS

- Grocery store owners
- Tulsa Transit/The Lift
- Service providers such as Uber, Lyft
- This Machine
- Amazon
- George Kaiser Family Foundation or other funders

KEY CONSIDERATIONS

- Liability agreement needed for operations on private property/other, Memorandum of Understanding (MOU) needed between City and property owner, ADA accessibility, coordination with bus service

CASE STUDIES/RESOURCES

- Minneapolis, Minnesota Mobility Hubs Pilot (2019)
- Identifying Best Practices for Mobility Hubs, Saki Aono, UBC Sustainability Scholar (2019)

METRICS

- Number of households in below-median income census tracts with convenient access to fresh food
- Cordon counts and before and after surveys monitoring first-time customers resulting from mobility hub

POTENTIAL FUNDING SOURCES

- George Kaiser Foundation
- Food Security Grants such as Tobacco Settlement Endowment Trust
- Amazon food security grant

COMPONENTS FOR SUSTAINABILITY

- Updated procurement might facilitate a new MOU model between landowners and Tulsa Transit and/or other appropriate entities such as mobility service providers
- Public-private-non-profit innovation partnerships
- City-wide Mobility Hub Plan. This pilot is proposed as part of a program of mobility hubs at grocery stores and other activity centers,as well as the termini of transit trunk lines

POTENTIAL MOBILITY ELEMENTS

- Enhanced Tulsa Transit **bus shelter**
- **Priority parking** for paratransit access

- Designated Transportation Network Company (TNC) pick-up and **drop-off zones**

- **MaaS**
- Shared mobility availability **kiosk** incorporating MaaS
- **Microtransit shelter**
- **Storage** for deliveries and for grocery delivery robots/ shuttles
- **Electric Charging**

- Enhanced walking safety and **connections** through surface parking and to bus shelter(s)
- Scooter **charging docks** (solar charge)
- **Bike share** (This Machine)
- Covered and secure **bicycle parking**
- V2X **Safe pedestrian tech**
- Curb cuts and related **universal design**
- **Bike lanes**

- Lot reconfiguration to prioritize **front-door access** for shared mobility/drop-off and pick-up areas
- Retention or **creation of spaces** for people with disabilities

- Seating and **waiting areas**
- **Signage** indicating Grocery Store Mobility Hub
- Parklet/benches and **tables** for eating
- **Landscaping**
- **Waste bins**
- **Lighting**

PRACTITIONER CHECKLIST

PROCUREMENT INNOVATION TOOLKIT

WHAT IS IT?

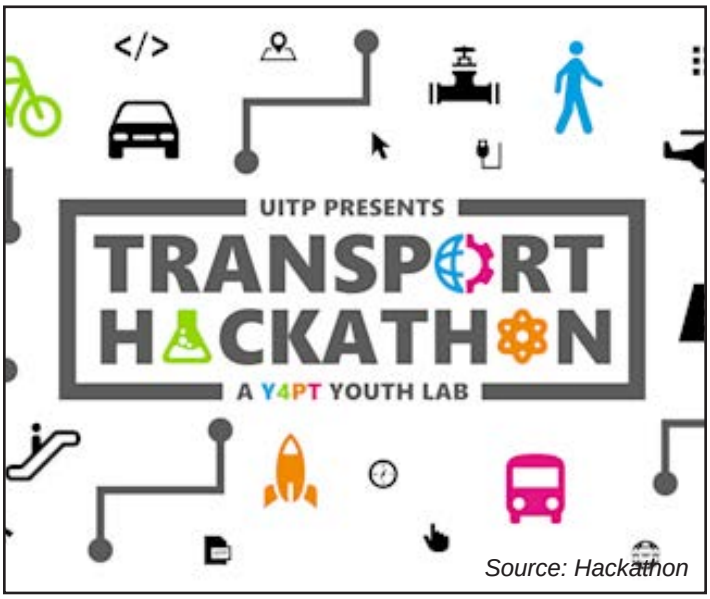
Procurement Innovation Toolkit consists of a set of practices and tools designed to facilitate and speed the development and deployment of new mobility technologies. The strategy taps existing procurement tools as well as identifies new public-private-philanthropic partnerships and creating funded innovation challenges. The toolkit may be used in combination with other innovation approaches such as the mobility innovation lab or an AV or cybersecurity "incubator."

WHAT DOES IT ACCOMPLISH?

The Procurement Innovation Tookit provides a **one-stop-shop** for Tulsa stakeholders for tools to tap procurement and facilitate innovation through technology. Traditional procurement approaches are much more appropriate for commodities and standardized services, and more comprehensive change is undoubtedly required to allow for large purchases of customized or non-traditional procurements such as cloud computing. The tools will allow the city to "try before it buys" and also to **advance mobility tech tools**. The suggested tools support proof of concept and pilots of solutions that are tailored to mobility needs of the city and its sister entities – other cities, the state, the MPO, tribal entities and universities. The Toolkit could **foster expansion of innovation challenges** funded privately or with existing funds, data and policy hackathons, or the development of tools that monetize data in a way that generates a shared revenue stream.

KEY INGREDIENTS

- Lists of in-kind and matching funds from private and state sources
- Concise guide to acquiring technologies that generate a shared revenue stream
- Approaches that allow for forming technology partnership as part of a grant application
- Resources and incentives available from other agencies such as INCOG or an economic development agency
- Catalog of cooperative procurement vehicles



Data hackathons like this one at Summit Stockholm 2019 engage a new wave of skills, demographics, and thinkers in trying to solve big challenges.

EARLY ACTIONS

- Assemble a set of procurement tools facilitating low-friction funding of proofs of concept and pilots. RFPs are best for commodities and traditional services.
- Identify flexible funding sources
- Create new forms of procurement including:
  - Technology/data partnerships with technology, regional businesses, and public agencies.
  - State Innovation Fund and innovation challenges
  - Tulsa seed money
  - Mobility services/technology broker cooperative agreements

PARTNERS

- Office of Finance, City of Tulsa
- INCOG
- Oklahoma Department of Transportation (ODOT)
- Regional universities of Tulsa
- Corporate and family foundations
- Tulsa Transit

KEY CONSIDERATIONS

- Proof of Concept and very early stage pilots should be coordinated with research or incubator community for validation and funding, cash, and in-kind “ownership”

CASE STUDIES/RESOURCES

- 3P to P3: Technology/Data P3s (Los Angeles DOT)
- State Innovation Fund (strong examples in Michigan, Minnesota, Virginia, New York)
- Tulsa seed funding (such as in Sacramento, Grand Rapids, Arlington, TX)
- Mobility services/technology broker (examples in Houston-Galveston Area Council of Governments, Denton County Transportation Authority, and Virginia Department of Rail and Public Transportation)

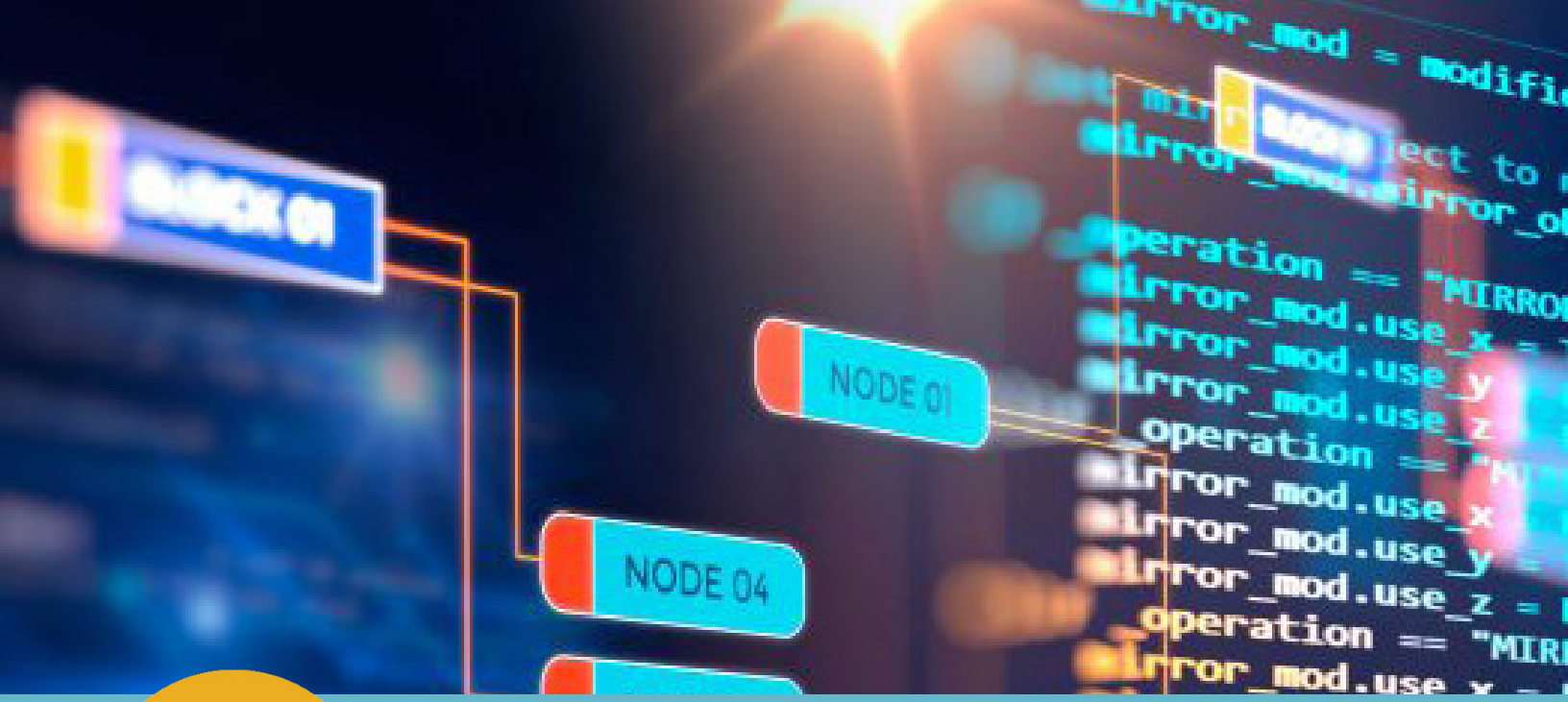
COMPONENTS FOR SUSTAINABILITY

- State legislative and executive branch support
- Transparency
- Private seed funding
- Return on Investiment (ROI) metrics
- Revenue generation
- Market awareness of procurement tools

State Transportation Innovation Councils offer technical assistance and funds—up to $100,000 per STIC per year—to support the costs of standardizing innovative practices in state transportation.

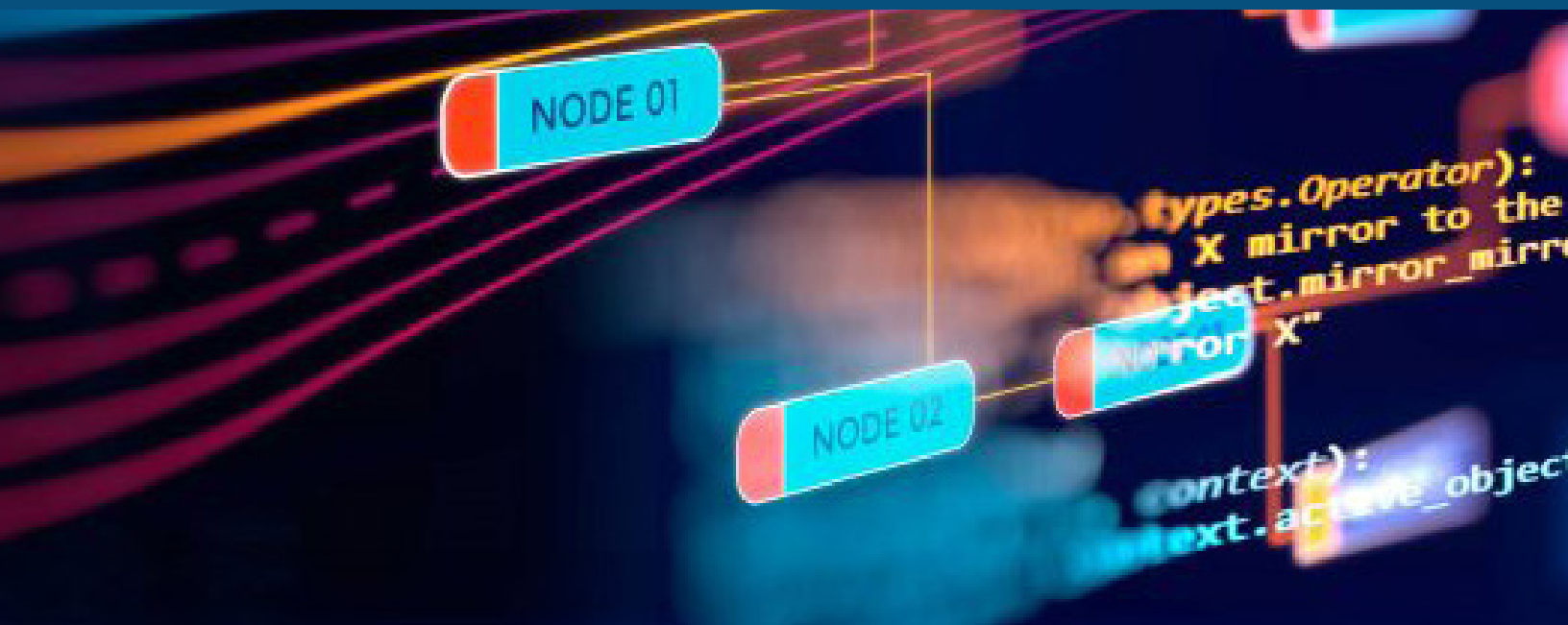
Houston Galveston Area Council Procurement Summary (2019)

Code the Curb is an undertaking to inventory more than 1 million signs, 37,000 parking meters, curb paint, and regulatory tools along 7,500 centerline miles of streets in Los Angeles. The complete digital inventory will allow for citywide dynamic pricing and regulations.



PRACTITIONER CHECKLIST

DATA SHARING POLICY



WHAT IS IT?

A policy that facilitates the sharing of data based on established use cases for data while prioritizing risk mitigation. The policy considers best practices and existing laws and regulations, in addition to addressing evolving privacy and data security issues.

WHAT DOES IT ACCOMPLISH?

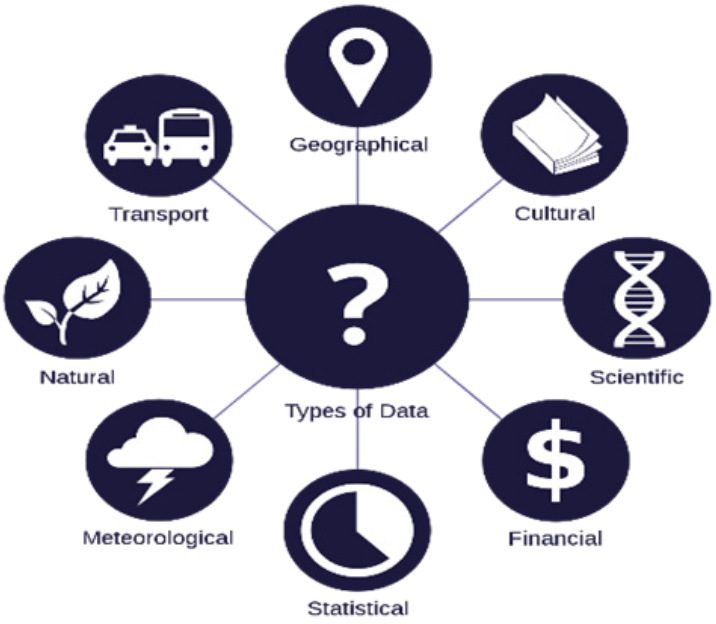
The policy will implement a practical data sharing approach that **aligns interests** between the public and private sector. The policy will allow Tulsa to be a leader in maximizing the value of data while mitigating risks and **promoting transparency** in the use of data, including geolocation information.

A strong data policy is valuable for a number of reasons:

- Data is an asset that should be leveraged for the **benefit of the public**
- Data is an important foundational tool for **unlocking the potential** around the future of mobility
- Ensuring **communities have access** to data for planning and regulatory purposes is important for promoting innovation, ensuring safety, and managing competing demands of the right-of-way
- The opportunity to develop rules and regulations **based on actual data** ensures more balanced and equitable deployment of next generation mobility solutions
- It gives Tulsa the opportunity to **lead and influence** best practices based on its goals

KEY DATA INGREDIENTS

- Data at different scales and from different sources
- Protocol for sharing
- Identified data contacts
- Triggers for updating data
- Defined privacy limitations
- Legal protection
- Public interfacing process
-



KEY CONSIDERATIONS

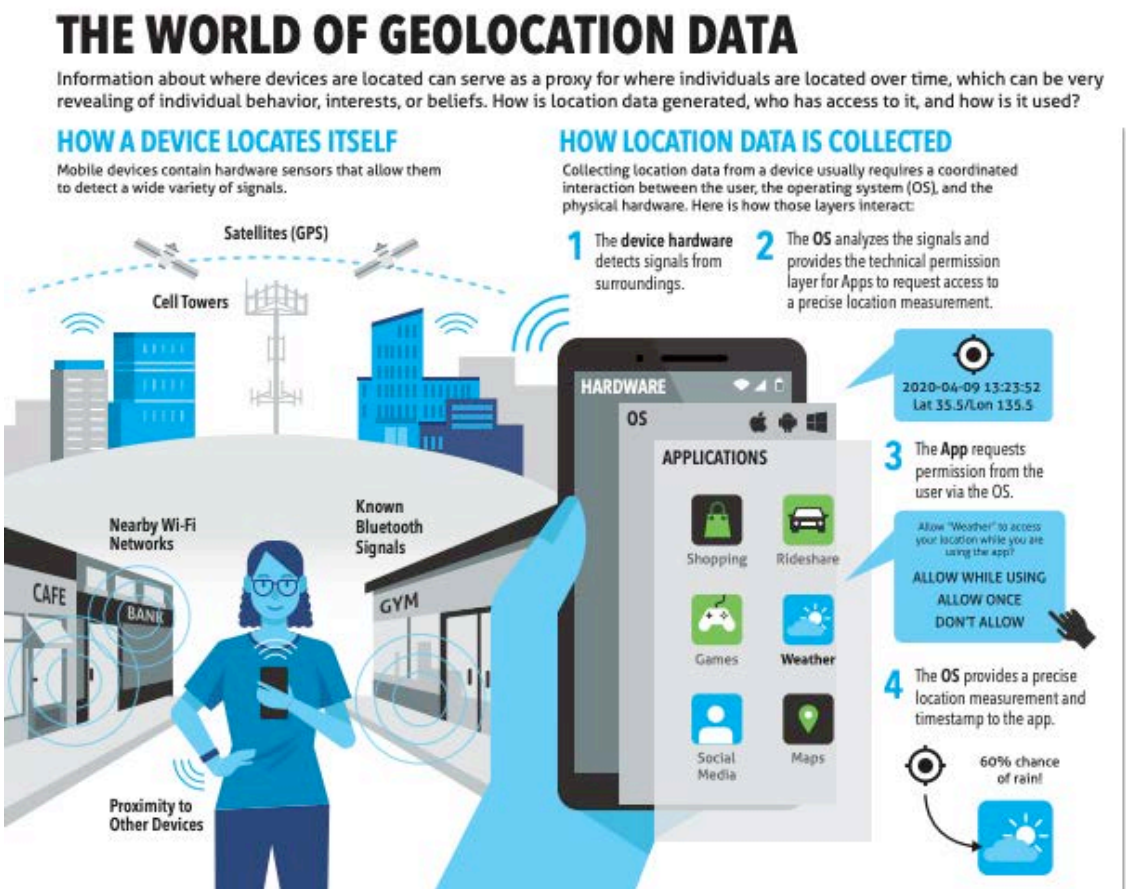
- Education and training needed for key staff members
- The need to engage legal counsel for compliance and risk mitigation
- The need to update policy as rules, regulations, and best practices evolve
- Public outreach and education should be planned around opportunities and responsible use of data
- Private sector and consumer focused organizations should be engaged
- Standardization of processes for addressing public records requests and law enforcement data requests

POTENTIAL FUNDING

- Privacy-focused organizations
- Equity-focused foundations
- Future USDOT programmatic funding through reauthorization
- P3 focused on use cases

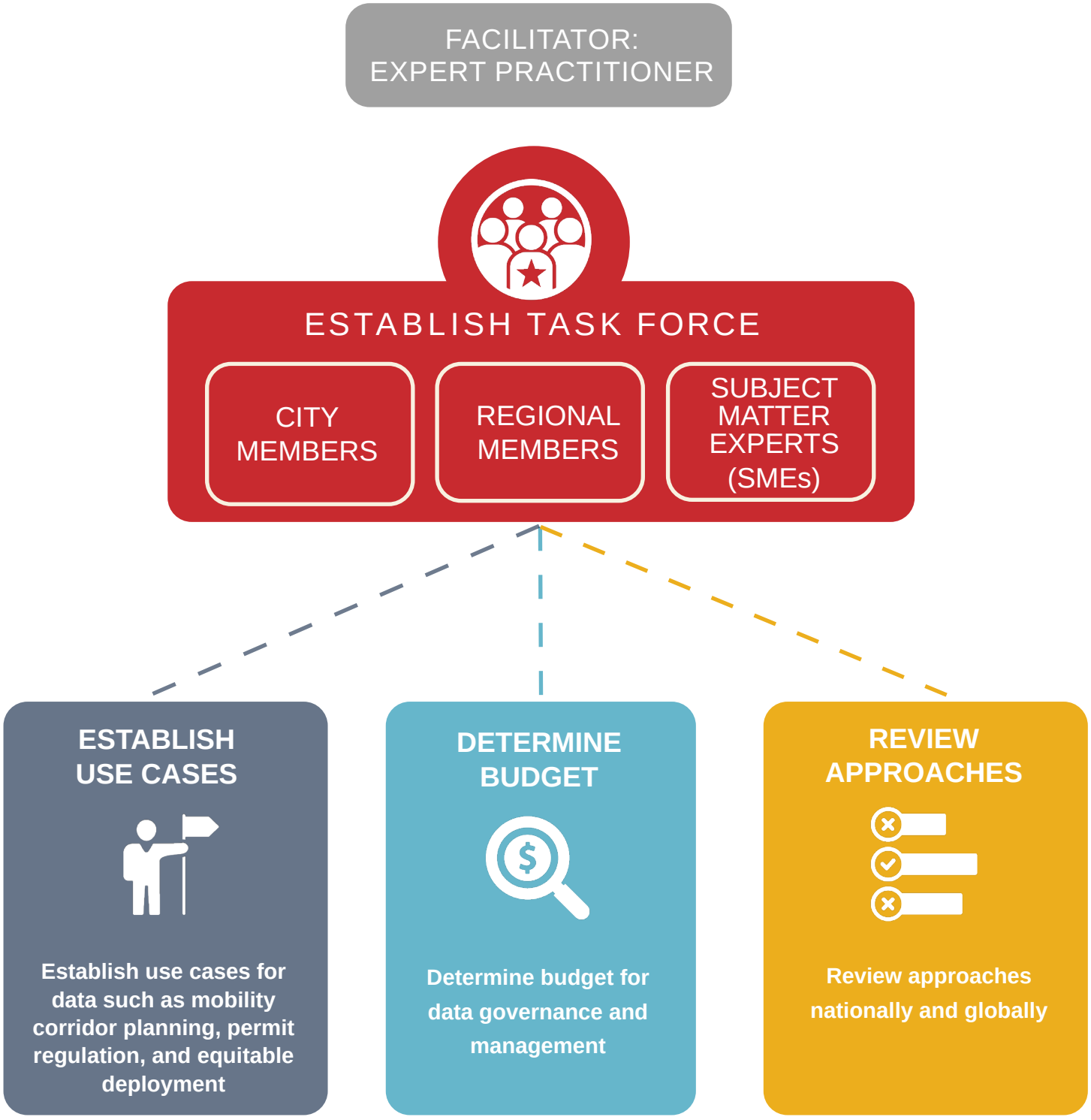
CASE STUDIES/RESOURCES

- City of Seattle's "About the Privacy" program
- LADOT's Mobility Data Specification Storymap
- SAE Mobility Data Collaborative "Guidelines for Mobility Data Sharing Governance and Contracting"
- Center for Democracy and Technology Smart Enough Cities Report "Governments That Seek Mobility Data Must Respect Individual Privacy"



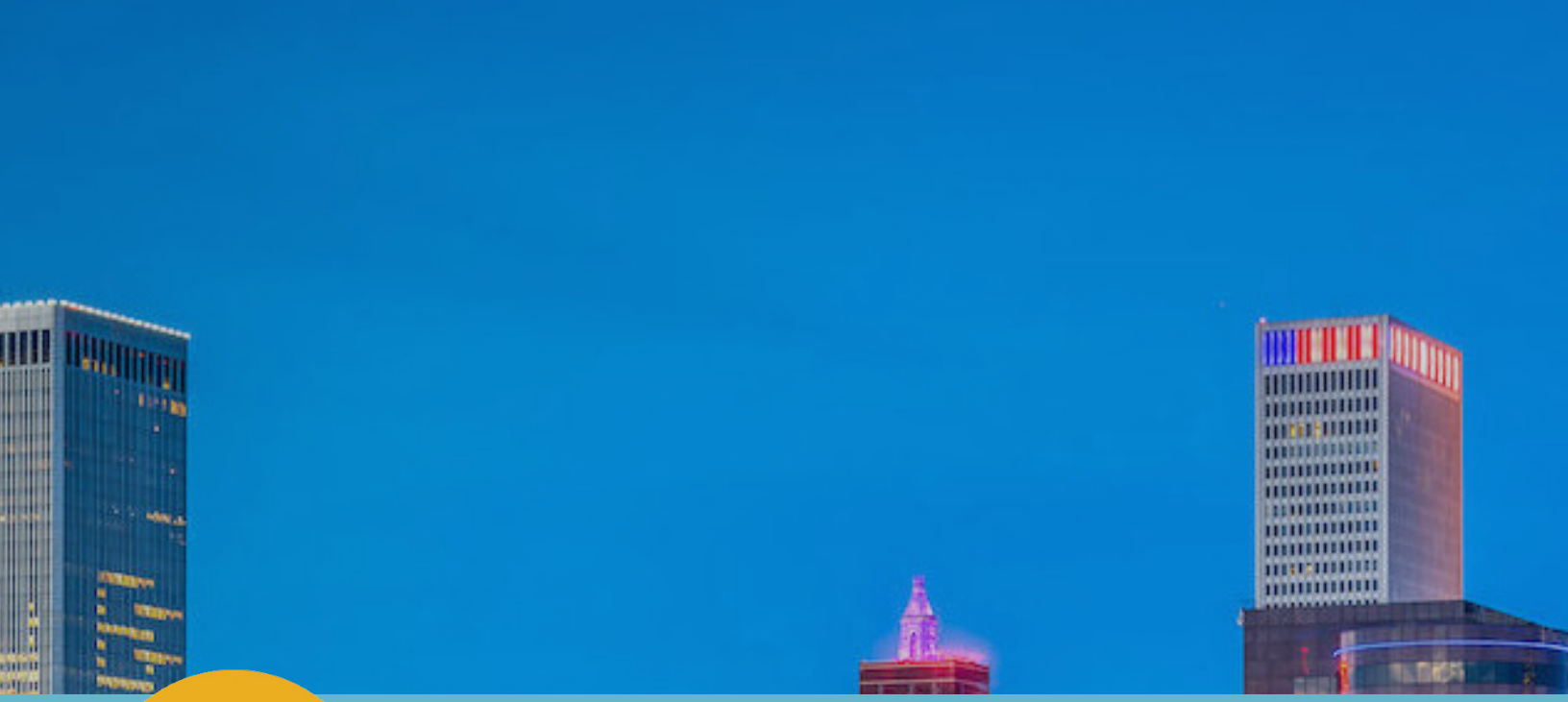
The Future of Privacy Forum (FPF) infographic, "The World of Geolocation Data," outlines how location data is generated from mobile devices, who has access to it, and factors to consider in evaluating privacy risks.

INITIAL STEPS



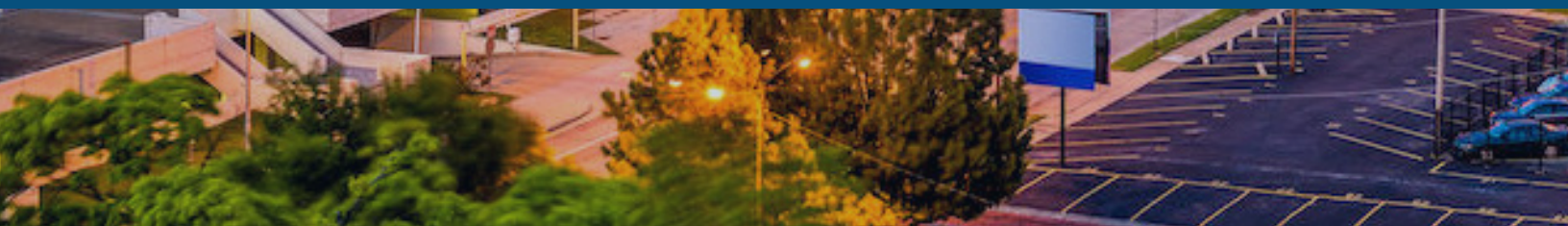
Example of potential membership:

City, INCOG, University, Law Enforcement, Consumer Facing and Privacy Oriented, Industry, Equity Focused, Citizen Representation



PRACTITIONER CHECKLIST

MOBILITY INNOVATION LAB/ DOWNTOWN BUSINESS IMPROVEMENT DISTRICT



WHAT IS IT?

The Mobility Innovation Lab, a public-private-philanthropic partnership (P4) hosted by the Tulsa Downtown Partnership would convert the downtown district into an incubator for innovation, economic development, equity, and environmental solutions. The streets and highways, curbs and sidewalks, transitways, and bikeways would serve as the proving ground for technology and planning solutions with mobility solutions that will **expedite equity**, environmental, and economic development advancements. The Mobility Innovation Lab's program of pilots will focus on challenges such as curbside management, expanding shared mobility, and connecting pathways for safe walking and biking. Other near- and mid-term opportunities include **addressing mobility** in the downtown **during the workday** through an electric shuttle, and showcasing AV technology with a pilot downtown.

WHAT DOES IT ACCOMPLISH?

The Downtown BID Mobility Innovation lab would **address crowded curbs** that impede the free flow of traffic as well as access to restaurants, retail, and other business. COVID-19 has compounded the need for pick-up and drop-off for all kinds of trips, including those that support e-commerce. **Digital inventories of the street, curbside, and sidewalks** could lay the groundwork for a more walkable, bikeable, walkable community in downtown and the adjacent Greenwood neighborhood. Collaboration with a company such as Shuffle, provider of electric shuttle services, would expand electric shared mobility, fill a gap in daytime connections in downtown, and promote a local business. An **AV Pilot Partnership** with Tulsa Transit, researchers, and businesses would introduce automated vehicle technology, and build on the region's cyber-security research assets. The Mobility Innovation Lab could **advance placemaking priorities** and be integral to efforts to attract talent and new investment in Downtown.

KEY INGREDIENTS FOR A QUICK-BUILD

- Expand mission of Downtown Partnership
- Create a program of pilots
- Scaleable solutions
- Identify Public-Private-Philanthropic Partnerships
- Maintain broad support
- Find early successes

EARLY ACTIONS

- Embed the Mobility Innovation Lab in the strategic plan of the BID
- Prepare and execute an MOU to partner with the City, a university, and one local strategic partner
- Convene business and residential stakeholders
- Secure agreement and funding for Shuffle Shuttle
- Demo potential technology partnerships
- Identify policy considerations for parking requirements and regulations
- Identify local business, research, and funding partners

PARTNERS

- Community, including Greenwood residents, businesses, human service providers, and investors
- Technology Providers
- INCOG
- Universities
- Urban Land Institute
- Francis Energy EV Charging
- Corporate and family foundations
- Tulsa Transit and mobility service providers including TNCs and This Machine

COMPONENTS FOR SUSTAINABILITY

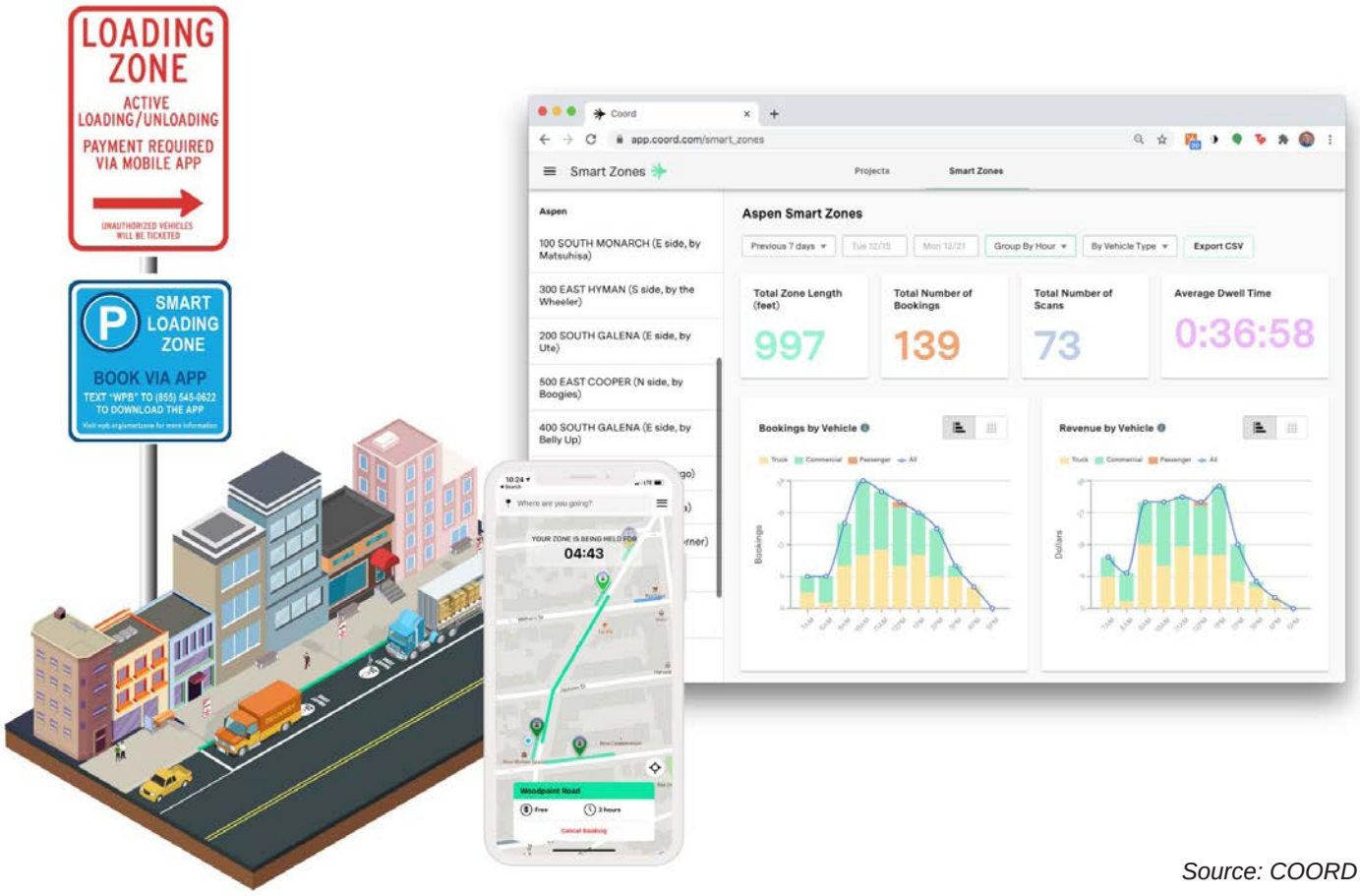
- Early wins that translate into long-term solutions for Tulsa
- Metrics that align with mobility, equity, and economic development objectives
- Creation of viable business models, post-pilot
- Innovation cycle that unites technology, civic, operational partners, and P4 Funding – public, private sector, philanthropic

POTENTIAL FUNDING SOURCES

- Matching from BID
- Coronavirus Aid, Relief, and Economic Security Act (CARES)
- USDOT grants
- Innovation grants (e.g., FAST, NSF rapid research, corporate foundations)
- National philanthropy (e.g., Kellogg and Knight Foundations for Healthy Communities and Equity and AVs)
- Regional businesses and Philanthropy

CASE STUDIES/RESOURCES

- Mobility Innovation Lab (examples through CityTech Collaborative, Sacramento Association of Governments, and North Texas Council of Governments)
- Curbside management techniques as seen in Coord's 2020 Digital Curb Challenge
- Technologies such as through Numina to identify and create safe places to bike and walk
- Program of AV pilots (strong examples in Rhode Island, Las Vegas, Columbus, Honolulu, Utah)



Source: COORD

Coord's 2021 Digital Curb Challenge invites up to three cities or other curb managers (e.g., universities, airports, private developments) to partner with Coord to conduct a free Smart Zone curb management pilot program.

Minnesota	Minnesota Technology Association
Mississippi	Innovate Mississippi
Missouri	Missouri Small Business Development Center
Montana	Montana State University
Nebraska	Nebraska Business Development Center, University of Nebraska at Omaha
New Hampshire	University of New Hampshire
New Mexico	Arrowhead Center at New Mexico State University
North Carolina	First Flight Venture Center, Inc.
Ohio	Ohio Aerospace Institute
Oklahoma	The University of Oklahoma Tom Love Innovation Hub

A sample of the 2020-2021 recipient organizations for the Federal and State Technology (FAST) Partnership Program Grants

Source: Indy Partnership

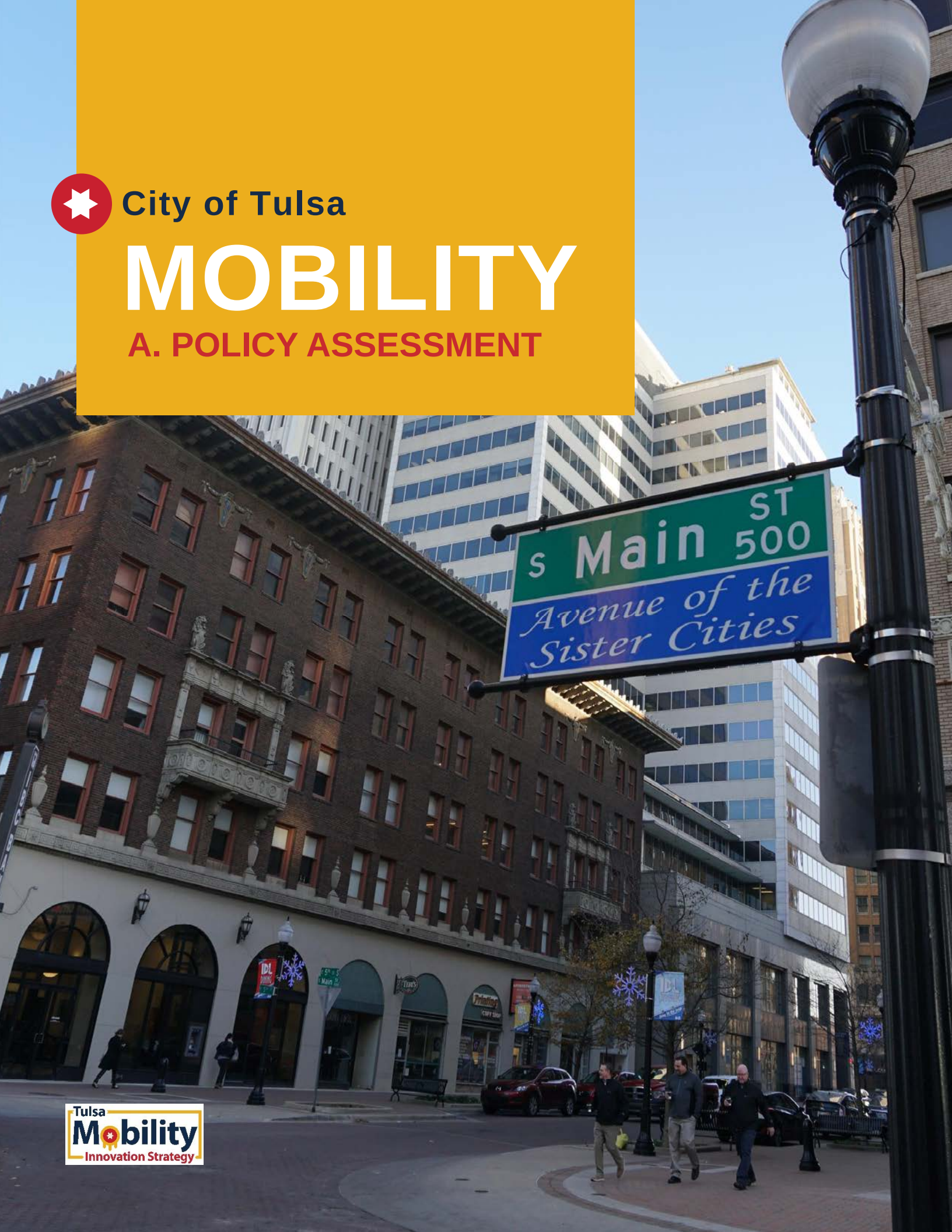
8. APPENDICES

A- Policy Assessment Report
B- Technology Assessment Report
C- Economic Assessment Report
D- Implementation Matrix

City of Tulsa

MOBILITY

A. POLICY ASSESSMENT



Tulsa Mobility Innovation Strategy

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A1. TULSA SMART MOBILITY POLICY ASSESSMENT

Tulsa is seeking to align its mobility vision with foundations through policy and consideration of existing state and local statutes and ordinances. As new mobility-focused innovations are deployed in communities, existing laws and ordinances can be tested as new smart mobility devices often do not fit neatly into existing definitions, regulations, and statutes. The challenge in every state and community is finding the right regulatory framework that effectively balances both safety and the continued deployment and evolution of new mobility solutions, particularly those incorporating new technologies like automation and demand responsive platforms.

With such goals and questions in mind, this policy assessment identifies and summarizes potential barriers to the continued deployment of smart mobility solutions in the City of Tulsa. Also, included as Attachment 1, is a snapshot of the roadmap forward around the development of a balanced and workable policy framework that seeks to promote the continued deployment of smart mobility solutions in the City of Tulsa to enhance mobility, promote continued economic development, and improve the quality of life for all Tulsans.

Based on outreach with key stakeholders, this effort is fueled by focusing on the true value of transportation and the connection between access to reliable, safe, and affordable transportation options and livability.

A1.1 AUTOMATED VEHICLES

The State has enacted Senate Bill 365 around the operation of automated vehicles on public roads. SB 365 seeks to include new definitions related to the operation of automated vehicles within the State and to reduce inconsistencies in the future enactment of laws related to automated vehicles. Lawmakers have acknowledged this legislation is only viewed as a first step related to the operation of automated vehicles in the State, and additional steps are needed to address the many untested legal and policy issues that automated vehicles bring with them. This is further exacerbated by the fact there is not yet an established federal regulatory regime around the operation of automated vehicles, and there will likely not be one in the near future.

The State Oklahoma has an important opportunity to promote the deployment of automated vehicles to address State and community goals. A number of states have enacted statutes related to the operation of automated vehicles within their jurisdictions. In Attachment 2 a table is provided with a side-by-side comparison of selected statues that track the initial discussions we have been privy to in Oklahoma around legislation associated with automated vehicles.

As noted in Attachment 2, the relevant issues that states are considering are the following:

- Definition of Automated Driving System: In seeking to define and consider that Level 4 or 5 automated vehicles will not require human intervention, states are seeking to find the

right definition of an automated driving system. There is a danger of being overly prescriptive with any definition before the technology has fully evolved, which can result in more confusion due to the levels of automation and use cases for the technology. Furthermore, any definitions should be considered in recognition of existing jurisdiction of the National Highway Traffic Safety Administration (NHTSA) over vehicle safety.

- Liability and Insurance: This is an important issue that will continue to evolve as more use cases for automated vehicles are identified and deployments continue across the country. It has been clarified in federal guidelines that states will continue to maintain their powers over vehicle insurance issues. As new fleet formats for automated vehicles are contemplated, there is an opportunity to consider new innovative insurance frameworks that seek to apportion risk more evenly to continue to promote new mobility focused innovations within communities in Oklahoma.

- Law Enforcement Coordination: Interaction with law enforcement has become an important topic around the integration of automated vehicles onto public roads. Some states have taken the approach of requiring law enforcement interaction plans in jurisdictions where deployments will occur. Engaging law enforcement should be a priority in developing the right framework for continued integration of automated vehicles into the State.

- Crash Data Reporting: A complicated evolving issue is how to manage the collection and sharing of data from smart mobility solutions. With automated vehicles, opportunities to require crash data to be shared can help with assessments of road safety and accident fault; however, there are certain risks and liabilities associated with the collection of data, including privacy considerations, that should be taken into account. Furthermore, issues such as privacy and cybersecurity need to considered around transportation focused technologies like automated and connected vehicles.

- User Fees: The issue of paying for future infrastructure needs is an important national subject. Automated vehicles have been discussed as a potential revenue source; however, the development of any new fee structures should be balanced to avoid creating an impediment to the deployment of new technologies. In Attachment 2, we provide the example of Tennessee that has outlined a framework in legislation for the implementation of user fees in connection with the deployment of automated vehicles.

- Registration and Licensing: In accordance with federal guidelines, states are currently expected to retain their existing powers around the registration and licensing of vehicles. However, a complicated question that has yet to be resolved is whether a driving test can be administered by a state to an automated vehicle where no driver is required in consideration of existing jurisdiction of NHTSA over the safety of vehicles. This is an issue that inspires coordination with neighboring states, especially as cross-state border innovation corridors are being evaluated.

- Safety Driver/Operator: Whether or not a safety operator or driver is required to be in a vehicle is an important consideration. Some states allow for no safety driver in a vehicle as long as remote monitoring is possible. However, this brings up considerations around ensuring wireless connectivity in all areas where an automated vehicle without a safety operator may be operating. Also, there is an opportunity to consider public outreach and engagement required as part of preparing automated vehicles for interaction with the public at- large. Finding a balance between automated and human-driven vehicles will likely be a challenge as the technology transitions into broader use.

- Equity and Accessibility: Our work is focused on the A2CES model, which includes a vision of Accessible, Automated, Connected, Electric and Shared vehicles. In our review, none of the listed statues include consideration of equity and accessibility, which may be an opportunity for the State and City to align goals and priorities.

Based on the attached summary and analysis above, we suggest the following considerations for future legislation for automated vehicles:

- Promoting a shared subscription service for automated vehicles that aligns with existing City of Tulsa code sections promoting Shared Active Transportation.

- Incorporating focus on equitable transportation solutions and exploring opportunities to foster partnerships for promoting use of automated vehicles for use cases that seek to fill identified transportation gaps in communities.

- Updating contracting requirements to foster public contracting that promotes transparency and flexibility around demonstration projects to keep up with the pace of innovation in the transportation space. Updating of procurement requirements also provides an opportunity to consider whether open records laws need to be revised to address issues related to privacy and trade secrets.

As noted above, the challenge and opportunity is finding the right balance to promote innovation and technology integration while also prioritizing safety and risk mitigation. We look forward to supporting further discussions on this subject and aligning this assessment with the development of mobility policies.

A1.2 MOBILITY POLICY FRAMEWORK DEVELOPMENT

As part of this assessment, the team has developed the attached Mobility Focused Policy Framework Snapshot to support the Tulsa Mobility Innovation Strategy. The overall goal and purpose of this initial framework is to outline a mobility policy framework that promotes safe and effective integration of new mobility innovations into Tulsa.

With the use of the term “smart mobility,” it is necessary to note that smart mobility is more than just automated vehicles as illustrated in the proposed policy issues in Attachment 1. Moving forward, the development of the mobility policies will track the ongoing project outreach and

align with the identified needs of Tulsa and its residents through the smart mobility vision and strategy development.

The framework is supported by the code audit completed, and issues identified in Attachment 3 around potential barriers for the continued deployment of smart mobility solutions within Tulsa and the State. In summary, the following issues have been identified as priorities through the audit:

- Existing Local Control: Aligning interests between the State and City around a smart mobility future that enhances economic opportunities and livability within the State is an important consideration. Maintaining existing local powers, especially around management of the right-of-way, will be important from an operational, solution-oriented, and safety perspective.

- Updating Definitions: A number of existing vehicle-related definitions have been identified in Attachment 3 as candidates for further evaluation and updates with consideration of the deployment of automated vehicles that also fit into the A2CES model.

- Building on Existing Foundations: The ongoing investments into Bus Rapid Transit by Tulsa Transit provide an important foundation for implementing mobility solutions, such as first- and last-mile connections and potential incorporation of models like Mobility Hubs. These require the evaluation of mobility solutions on the basis of identified needs and geography within neighborhoods that have public transit connections.

- Prioritizing Equity and Accessibility: Aligning the mobility strategy with the use of innovation to fill existing transportation gaps and to improve mobility freedom for all Tulsans presents a great opportunity for this project.

- Land Use: The opportunity to merge ongoing housing and economic development initiatives by the City and smart mobility offer the chance to focus on Mobility Oriented Development. This includes rethinking use of existing space and prioritizing mobility needs in a more equitable and holistic manner. It also requires aligning mobility work with reevaluation of existing land use approaches, and engaging in initiatives that include digitizing the curb to support Tulsa's investment in a mobility innovation strategy.

- Coordination with Law Enforcement: As mentioned throughout this assessment, coordination with law enforcement will be important with the introduction of new smart mobility options into the City. New considerations around traffic enforcement will be important.

- Procurement and Contracting: Ensuring that procurement processes provide the flexibility and nimbleness required with technology should be an important part of the strategy. Focusing on innovation does not mean that important fundamentals around transparency need to be lost. However, making sure that new and innovative

partnerships are supported will be important, especially when considering important issues like funding.

- Data Governance and Privacy: With technology comes complicated and evolving issues regarding data management. The collection, use, and analysis of mobility offers opportunities to support planning around future infrastructure investments and project prioritization. By developing a mobility data policy and privacy focused framework, the City will be able to maximize opportunities around data analysis while also mitigating risks and preserving privacy.

A1.3 CONCLUSION AND NEXT STEPS

We hope this assessment identifies issues and provides a roadmap to support the development of a policy framework that aligns with the development of a mobility innovation strategy for the City. We look forward to feedback on the MIS so that the City and INCOG can align the mobility focused framework for years to come.

A2. ATTACHMENT 1: MOBILITY FOCUSED POLICY FRAMEWORK SNAPSHOT FOR TULSA MOBILITY INNOVATION STRATEGY

PRIORITIZE INNOVATION AND TRANSPORTATION

- Automated Vehicles: Safe and effective incorporation of automated vehicles into transportation system with focus on A2CES (Accessible, Automated, Connected, Electric and Shared) model

- Micromobility: Promoting incorporation of new demand-responsive mobility solutions into transportation, including analysis of ongoing deployment of Mobility Hubs in communities

- Fare Payment Integration: Aligning work being done by Tulsa Transit around modernizing fare payments to determine opportunities for fare payment integration while still considering equity from an unbanked and digital divide perspective

- Unmanned Aerial/Ground Systems: Ensuring opportunities to evaluate potential use cases as technology continues to evolve and be deployed

PRICING / VALUE OF TRANSPORTATION

- Education: Opportunity to educate citizens about the true cost and value of transportation, especially through lens of equity to provide more reliable, safe, and affordable transportation options to Tulsans. This also provides opportunity to address “hidden tax” of car ownership identified during outreach meetings, and safety issues associated with some drivers being unable to afford vehicle insurance.

- Reducing Single Occupancy Trips: Aligning congestion reduction and transportation efficiency maximization into the mobility framework, including consideration around new forms of shared mobility that focus on transportation demand management and access to job centers

INNOVATION FOCUSED ON ACCESSIBLE AND EQUITABLE MOBILITY OPTIONS

- Paratransit: Promoting opportunities around innovation-focused partnerships with the goal of increasing access to services and improving efficiency, costs, and utilization. Underlying services to Tulsans most in need should continue to be prioritized.

- Unbanked and Unconnected: Any smart mobility framework will need to ensure consideration of unbanked users that may not have data plans for smart devices.

- Costs: Exploration of opportunities to ensure safe, reliable, and affordable mobility options

- Youth: Prioritizing access to reliable, safe, and affordable transportation options for youth, which supports access to education goals

- Inclusivity: Focus should be not only first- and last-mile trips, but also first- and last-50 feet and first- and last-50 miles. There is opportunity to align with needs specific to aging populations, and other regional needs/considerations relevant to livability and economic development.

LAND USE

- Align framework with ongoing economic development initiatives by the City and partners.

- Align discussion between housing and transportation through innovation and new mobility options.

- Focus on incorporation of innovation on job focused corridors, including incentivizing collaboration with employers around transportation demand management.

- Align framework with ongoing discussions around zoning, parking and curb management.

- Explore models like Mobility Hubs to ensure first-and last-mile connections that are both need and geographically based in addition to complementing ongoing investments into public transit.

RESILIENCY

- Ensure consideration of future infrastructure needs to support the mobility innovation strategy, including electric vehicle infrastructure and automated and connected vehicles; this includes opportunity to leverage City's investments into fiber.

- Consider new challenges around the disposal of e-waste and how to educate the public.

- Incorporate futureproofing at the design stage of new public works projects at all levels.

- Consider integrating low speed, shared active transportation lanes to promote shared mobility.

PARTNERSHIPS

- Develop innovative procurement and contracting to allow for streamlined integration of technology, including consideration of unsolicited proposal models being implemented around innovation and transportation.

- Review open records requirements and clarify exemptions to ensure issues related to privacy and protection of trade secrets promote technology focused partnerships.

- Reduce compartmentalized approach to public works projects focused on innovation, and breaking down silos between planning, design, policy and legal parties.

- Encourage collaboration agreements across stakeholders to maximize participation, input and buy-in of City's investments in mobility and innovation focused strategy.

SAFETY AND LAW ENFORCEMENT COORDINATION

- Coordinate with law enforcement as the incorporation of new mobility innovations are considered.

- Rethink traffic management and enforcement with an eye towards technology to manage effective use of resources and promote public safety.

MOBILITY DATA GOVERNANCE AND PRIVACY

- Develop mobility data policy and privacy focused framework to ensure maximization of opportunities around the collection and analysis of mobility data while also considering privacy and user trust.

- Data storage and management presents opportunities for partnerships with universities to efficiently store and manage data in accordance with recognized standards and best practices.

A3. ATTACHMENT 2: STATE-LEVEL ANALYSIS FOR AUTOMATED VEHICLES

Topics	California	Texas	Florida	Michigan	Arizona	Vermont	Pennsylvania	Maryland	Washington	Tennessee
Relevant Laws	[To be Inserted]	SB 2205 (Bill Text)	Public Law 311	Public Acts 332, 333, 334, 335 (2016) and 231 (2013)	Governor's Executive Order (EO 2018-04)	SB 149	SB 1267, HB 1958, PennDOT AV Testing Guidance	No legislation, but MDOT has passed regulations to allow testing, the process is outlined here	HB 2970 (mandates the convening of a working group) EO 17-02	SB 598, 2333, 1561, 676, 151
Definition of automated driving system	"Autonomous technology": Technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator.	"Automated driving system": The hardware and software that, when installed on a motor vehicle and engaged, are collectively capable of performing, without any intervention or supervision by a human operator: (a) all aspects of the entire dynamic driving task for the vehicle on a sustained basis; and (b) any fallback maneuvers necessary to respond to a failure of the system.	"Automated driving system": The hardware and software that are collectively capable of performing the entire dynamic driving task of an autonomous vehicle on a sustained basis, regardless of whether it is limited to a specific operational design domain.	"Automated driving system" The hardware and software that are collectively capable of performing all aspects of the dynamic driving task for a vehicle on a part-time or full-time basis without any supervision by a human operator.	"Automated driving system": The hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operational design domain.	Sec. 13 23 VSA Chapter 41: "Automated driving system": The hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis within its operational design domain, if any, including achieving a minimal risk condition, without any intervention or supervision by a conventional human driver, where applicable.	PennDOT's definition of an "HAV" is A motor vehicle with [sic] equipped with an ADS that can operate in high or full automation and where the ADS performs the dynamic driving task with no requirement that a driver, or a safety driver respond to any request to intervene or take control of the vehicle. This definition encompasses automated vehicles considered to be Level 3, 4 or 5 under SAE J3016.	Exclusively for the purposes of their permitting process, an "HAV" is defined as any combination of hard ware and software t hat perform one or more driving functions (e.g., free way driving, autom ated taxi, self-parking) by control-ling and combining braking, throttle and steering functionality. The capability of a system is broken down into levels depending on the system's ability to monitor the driving environment and perform some or all of the driving functions as defined by SAE J30 16.	Referenced but not defined.	"Automated driving system" or 'ADS": Technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed in high or full automation mode, without any supervision by a human operator, with specific driving mode performance by the automated driving system of all aspects of the dynamic driving task that can be managed by a human driver, including the ability to automatically

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								In this document, an HAV system is one that is SAE Level 3 and higher.		bring the motor vehicle into a minimal risk condition in the event of a critical vehicle or system failure or other emergency event. SB0151
Liability	Liability is on the manufacturer testing/operating the technology.	The owner of the automated driving system is considered the operator of the AV for the purpose of assessing compliance with applicable traffic or motor vehicle laws.	Liability is retained by the owner-operator of vehicle.	Manufacturer retains liability.	The Automated driving system will be considered to be licensed, and the owner of the vehicle retains liability.	The automated vehicle tester retains liability.	From PennDOT: "When the automated driving system (ADS) is not engaged, then the licensed driver operating the vehicle will presumably be subject to all applicable "rules of the road" and the Common-wealth's laws regarding liability as if they were driving a non-HAV. Determining who is responsible for an accident with an ADS	Permitting process includes the following language alongside other issues to address "Agreement that test operators are to be responsible for following all traffic rules of the road, and responsibility of all traffic violations in the HAVs being tested on roadways open to public travel, are that of the permit holder."	Not explicitly mentioned.	With respect to each SAVE project, while the ADS is in control of the vehicle, the applicable motor vehicle manufacturer shall assume liability for incidents where the ADS is at fault for such incident, but in all cases consistent with existing insurance law and other laws.

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							operated HAV is not yet clear, but commentators suspect that it will involve application of traditional state tort and product liability laws, in addition to any new laws or regulations enacted or adopted to address HAV-related liability."			
Insurance	Must provide proof of insurance/self-insurance for $5 million in personal injury, death, and property damage/liability.	Standard level of insurance for the vehicle, equal to the amount of coverage that is required under state law.	Primary liability coverage of at least $1 million for death, bodily injury, and property damage. Personal injury protection and uninsured/underinsured coverage as required by other state laws.	Manufacturer must submit proof that the vehicle is insured based on normal state requirements.	Regular vehicle insurance requirements are retained.	Proof of $5 million of liability insurance, self-insurance, or a surety bond to cover damages by reason of bodily injury, death, or property damage caused by an automated vehicle while engaged in automated vehicle testing.	Required to meet normal state insurance requirements. (Chapter 17 of Title 75 of the Pennsylvania Consolidated Statutes)	Applicants must provide proof of liability and insurance coverage including: (1) Evidence of ability to satisfy a judgment or judgments for damages for personal injury, death, or property damage caused by a vehicle in testing	For vehicles with or without human operators present insurance or other proof of financial responsibility is required under RCW 46.30.020 (and affirmed by EO 17-02)	Further insurance is not explicitly mentioned.

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								in the form of an instrument of insurance, a surety bond, or proof of self-insurance, for no less than 5 million U.S. dollars. (2) All testing vehicles must carry motor vehicle insurance. The manufacturer or other entity permitted to test HAVs is the liable party for any of their vehicles and drivers / operators of their vehicles.		
Law Enforcement Coordination	Coordination: Plan to deal with law enforcement is required as part of the permitting process for testing organizations. For testing without a safety driver, this interaction plan	Coordination: None discussed directly. May be part of the Texas Autonomous Alliance. Enforcement: Local law enforcement will enforce traffic law like normal, with manually	Coordination: Not discussed directly. Enforcement: Vehicle owner or the vehicle itself must promptly contact law enforcement agency to report the crash.	Coordination: State police is included in the Michigan Council on Future Mobility to issue recommend-ations. Enforcement: Crashes must be reported to	Coordination: Arizona Dept. of Public Safety is currently working on a law enforcement interaction protocol addressing fully autonomous vehicles.	Coordination: Working closely with law enforcement is highly valued. An AV testing permit may be voided and invalidated for the trip by a law enforcement officer who determines there	There are crash reporting requirements. Law enforcement accessible failsafe's are required, too.	"The entity will file one Application for HAV Permit for each vehicle to be tested; each vehicle is to have a unique permit number that is accessible to law enforcement."		Vehicles must be equipped with automatic crash notification technology meaning "a vehicle service integrating wireless communications and vehicle location technology for

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	must provide how to contact the remote operator and how to remove vehicle from the roadway. Enforcement: Collision Reports are required to be submitted to the DMV for all incidents involving an AV.	operated vehicles.		local law enforcement promptly.	Enforcement: Normal traffic law enforcement, including responding to incidents promptly.	is a violation of any condition or that the continuation of the trip would be unsafe. Enforcement: Operator is required to report to the Agency of Transportation and applicable law enforcement agency within 72 hours after any AV testing crash that results in personal injury or property damage. Continuing to operate/test in the face of a suspension/ revocation shall be a penalty of not more than $1,000.				the purpose of determining the need for or facilitating emergency medical or law enforcement response in the event of a vehicle accident." Other crash data recording is required, as well.

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Reporting Requirements	California has the most stringent reporting requirements of all states. All license plate numbers / VINs for test vehicles must be provided to the state. Disengagement reports are required yearly from all operators (a measure of the number of times the AV system disengaged per total miles driven in autonomous mode). Collision Reports are required for each collision involving a registered AV, including if it was operating in "conventional" mode.	"An automated vehicle must be equipped with a "recording device" that meets the definition in Texas Transportation Code 547.615 and whose purpose is to record information that can be retrieved after an accident." (from TTI)	Reporting and/or data collection not discussed directly.	"A motor vehicle manufacturer may participate in a SAVE project if it self-certifies to all of the following… …A data recording system that has the capacity to record the automated driving system's status and other vehicle attributes including, but not limited to, speed, direction, and location during a specified time period before a crash as determined by the motor vehicle manufacturer." "Before commencing a SAVE project,	Certification letter is required to be submitted to Department of Transportation – meets FMVSS standards (unless waiver issued), achieve a minimal risk condition if ADS unable, capable of complying with all traffic regulations, meets all certificate, title registration, licensing, insurance requirements. No ongoing reporting requirements.	"The automated vehicle tester shall submit a report to the Traffic Committee annually, until all testing ceases, summarizes results and observations related to safety, traffic operations, interaction with roadway infrastructure, comments from the public, and any other relevant matters."	"That the HAV is equipped with a means to record operational data before a collision occurs. The data shall be made available to PennDOT and applicable law enforcement agencies upon request". Road usage, testing locations, vehicle numbers and other information is required to be reported semi-annually. Data Reporting, Crash Reporting. link	The permit process guidance doc states "A process framework is set out herein. Each case will be handled according to its unique circumstances and this framework provides the flexibility necessary to accommodate many different testing scenarios." The guidance document includes "Reporting Crashes" and "Regular reporting and Renewal Application" as items to be addressed during the permitting process without further specifics.		A motor vehicle manufacturer shall maintain incident records and provide periodic summaries related to the safety of the participating fleet to the department, the transportation and safety committee of the Senate, the Transportation Committee of the House of Representatives, and the NHTSA. (c) Prior to commencement and during the operation of a SAVE project, the manufacturer shall make publicly available a privacy

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	For testing without a safety driver, need to report on ODD of the vehicle, a list of all public roads for testing, the date testing will start and times that testing will be ongoing.			and for the duration of the SAVE project, the motor vehicle manufacturer shall make publicly available a privacy statement disclosing its data handling practices in connection with the applicable participating fleet." No other reporting requirements stipulated.						statement disclosing its data handling practices in connection with the applicable participating fleet. Individuals participating in any SAVE project, by their participation, are deemed to consent to the collection of the data described in subsection (b) while they are in the vehicle and the later provision of anonymized data summaries to the department, the Transportation and Safety Committee of the Senate, the Transportation Committee of the House of

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										Representatives, and the NHTSA.
User Fees	Application fees required to get testing permit. $3,600 non-refundable application fee, payable annually (for up to 10 vehicles and 20 drivers/operators) $50 fee for an additional 10 vehicles and 20 drivers/operators.	None listed.	None listed.	None listed.	None listed.	None listed.	None listed.	None listed.	None listed.	Pursuant to the department's authority to promulgate rules, the department may establish a fee to be charged to a manufacturer for the operation of a SAVE project. The fee authorized pursuant to this section must not exceed an amount necessary to implement this chapter.
Registration & Licensing	Testing on public roads can commence once the manufacturer certifies to the DMV that they have tested their vehicle-controlled conditions that simulate, as	The Automated driving system is considered to be licensed to operate the vehicle. Registration and titling is required as normal.	According to the NCSL, Florida allows an on-demand autonomous vehicle network to operate pursuant to state laws with the same insurance	Prior to testing, the manufacturer or upfitter shall submit proof satisfactory to the Secretary of State that the vehicle is insured. They	No registration required if safety operator is present. Without safety operator, organization must provide a written statement to Arizona DOT	Must apply to the Traffic Committee, listing the scope and ODD for test. Local governments will be informed 60 days prior to	Vehicle registration is required and must be submitted as part of applications for testing.	Identification of each test operator, their driver's license number, and the jurisdiction in which the operator is licensed. Identification of each vehicle to be	Developers shall self-certify that they are compliant with the requirements of the EO before	No license is required for ADS-operated vehicles. State notification is required to begin a project. Motor vehicle manufacturers

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	closely as practicable, each ODD where they will be testing.		requirements applicable to a transportation network company (TNC).	shall also demonstrate that this vehicle will only be operated by an employee, contractor, or designee, who has the ability to monitor the vehicle's performance and promptly take control if necessary. For vehicle platooning projects, a plan for operations must be filed with the State Police and DOT – if not rejected within 30 days, the platoon is allowed.	prior to commencing testing that acknowledges that – vehicle meets all FMVSS standards (unless waiver has been issued), vehicle will achieve a minimum risk condition if ADS fails, vehicle is capable of complying with all regulation, vehicle meets all title, registration, and insurance requirements.	testing commencing.		used for testing, with VIN or serial number, vehicle type, and other unique identifiers such as the year, make, and model. Self-certification of previous testing under controlled conditions that simulate real world conditions. A copy of Safety Assessment Letter (SAL) submitted to NHTSA for the vehicle(s) being tested or a description of the vehicle's ODD and self-certification that the SAL points have been addressed. Titling and registration for each vehicle to be used for testing. Identification of any wireless	beginning a pilot program. For vehicles with a human operator present, the operator must have a valid U.S. driver's license.	also must self-certify that they meet the requirements of § 55-54-104, and they must disclose certain operations information. Only motor vehicle manufacturers are eligible to commence projects under the SAVE act.

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								communication components of the test. **Existing state laws seem to be applicable as well.		
Safety Driver/ Operator	Manufacturer must provide a list of all operators/safety drivers to the State of California, with a list of drivers' license information. (Also, option to test without safety drivers)	No safety driver needs to be present in the vehicle, as long as the vehicle can comply with applicable traffic and motor vehicle laws	A fully autonomous vehicle may operate in Florida regardless of whether a human operator is physically present in the vehicle.	Safety driver not required when testing or operating on public roads.	No safety operator is required, provided the above declaration is followed.	Required to be in all test vehicles in the driver's seat, ready to take control. Also, has completed the tester's safety course.	Under existing law, unmanned and/or remote testing on trafficways is prohibited. Under existing Pennsylvania law, the driver of any vehicle is a natural person who drives or is in actual physical control of a vehicle. Currently, during Highly Automated Vehicle (HAV) testing, a licensed driver is required to be seated in the driver's seat with	Must be identified, licensed. The applicant must self-certify that HAV safety training has been provided to operators.	For vehicles operated with a human operator: • Vehicles shall be operated or monitored only by a trained employee, contractor, or other person authorized by the entity developing autonomous technology. • Vehicles shall be monitored, and an operator must have the	

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							the ability to intervene in situations where the Automated Driving System (ADS) experiences a system interruption or other problem rendering the ADS unable to safely perform the dynamic driving task and the vehicle is unable to come to a minimal risk condition on its own. PennDOT AV Testing Guidance There's an exception for a separate category of vehicles- (b) Highly automated work zone vehicles.--the department		ability to direct the vehicle's movement if assistance is required. Vehicles without human operators: • Vehicles shall be equipped with an automated driving system that performs all aspects of the driving task on a part- or full-time basis within the vehicle's operational design limits, and it must be capable of bringing the vehicle to a safe condition	

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							or the Pennsylvania Turnpike Commission, as applicable, shall authorize the locations in Pennsylvania on a periodic basis to implement the deployment of a highly automated work zone vehicle. a driver may be required in a highly automated work zone vehicle when used in an active work zone. Link		in the event of a system failure. • Vehicles shall be capable of being operated in compliance with Washington State motor vehicle laws relevant to the vehicle's operational design limits.	
Equity and Accessibility	No mention.	No mention.	None mentioned.	Not mentioned.	No mention.	No mention.	No mention.	No mention.	No mention.	No mention.

A4. ATTACHMENT 3: POLICY AUDIT

Policy Area	*State*	*Local*	*Comments / Further Consideration*
Local Coordination and Collaboration	SB 365 seeks to include new definitions related to the operation of automated vehicles within the State and to reduce inconsistencies in the future of enactment of laws related to automated vehicles. This includes limiting municipalities from enacting regulations that prohibit, restrict or regulate the operation of motor vehicles with driving automation systems. The State legislature is also leading a task force to discuss future laws and policies for automated vehicles in the State.	N/A	*Comment(s)*: Determining the appropriate coordination with local governments in future legislation, including the City of Tulsa, is important to align goals and opportunities around the deployment of automated vehicles. *Further Consideration*: City should continue to stay engaged with the Legislature to align goals and opportunities for automated vehicles. Consideration should be given to the important role communities will play in the successful deployment of automated vehicles and determining the appropriate use cases. Engagement with law enforcement will also be important from a public safety perspective.
Registration/ Licensing	State of Oklahoma handles all vehicle registration and driver licensing functions.	City-level licensing for taxis, “utility vehicles”, and shared active transportation. City fleet vehicles must be on a central record, with numbering and ID. Utility vehicles must be registered before use, and this registration shall be renewed on a biennial basis thereafter.	*Comment(s)*: Moving forward, consideration of classifications and definitions will be important. For example, there is an opportunity to clarify that Low-Speed Automated Vehicles (LSAVs) would be permitted on public roads by clarifying existing classification under State law stating that “low-speed electric vehicles” may be covered as Class A-C commercial vehicles. Additional opportunity to clarify that LSAVs may be classified as utility vehicles even if they do not have an internal combustion engine. *Further Consideration*: Determine which definitional categories allow opportunities for updates to consider new smart mobility innovations to reduce barriers and uncertainty. (*See below for list of definitions that could be focus for effort to update to reduce barriers and uncertainty related to smart mobility*)

Policy Area	*State*	*Local*	*Comments / Further Consideration*
Infrastructure & Right-of-Way Management	Oklahoma DOT is responsible for the state highway system, but grants specific rights to municipalities under Title 11 (Cities and Towns), Section 36-1 through Section 36-4 (Streets and Roads: "A municipal governing body may, in the manner provided by law, regulate and control the use of streets, roads, and other public ways within the limits of the municipality."	Temporary ROW use requires a city permit. This is governed by provisions in Section 906 of Chapter 9 (Infrastructure Development Permit Fees). ROW vacation is governed by Section 1219. Chapter 10 on Bicycles also includes relevant language on how slower vehicles use the ROW.	*Comment(s)*: Existing and express powers allocated to the City over the management of the right-of-way should be preserved and future legislation should not seek to limit such control. Instead, efforts to align interests around reduced congestion, mobility efficiency, equity and accessibility and economic development should be prioritized. *Further Consideration*: Opportunity to coordinate technology integration framework for automated vehicle deployment. Also chance to examine Chapter 14 (Special Events) of Municipal Code for relevant provisions around technology demonstrations.
Electrification (Electric Vehicle Infrastructure & Permitting)	No state-level laws specifically about electric vehicle infrastructure.	Private property and ROW installations appear to require city-level permits.	*Further Consideration*: As technology and use cases evolve, coordinate around placement of electric vehicle infrastructure in ROW and develop clear and concise permitting process. Opportunity to incorporate electric vehicle infrastructure into land use approvals.
Procurement	State open records laws allow for some information to stay confidential. 24A.10: "If disclosure would give an unfair advantage to competitors or bidders, a public body may keep confidential records relating to: (1) bid specifications for competitive bidding, (2) contents of sealed bids."	Section 413 (Performance-based efficiency contracts) and Section 414 (sole source and sole brand acquisitions) give discretion to the mayor to be flexible, given a unique product or service provided. Section 412 also allows for cooperative purchasing agreements, which may be useful as well.	*Comment(s)*: Federal funding circulars on fair and open competition recommend open bidding. Use of sole-source contracts when federal funding is involved require appropriate justification. *Further Consideration*: City of Tulsa can examine updating procurement guidelines for technology service contracts that also consider use of innovation for transportation. Opportunity to develop unsolicited proposal process around transportation and innovation, in addition to more flexible and streamlined contracting process for demonstration projects.
Liability / Insurance	Specific vehicle insurance is described in Title 36/Section 706 and Section 6656. Vehicle insurance is required for registration.	Contract liability is described in Title 18, Chapter 1, Section 101. The Mayor can determine the amount of indemnity required, which must be above $10,000 for accidents involving multiple people and $1,000 for property damage.	*Comment(s)*: Evaluation of appropriate insurance amounts and consideration of new insurance models is encouraged. Opportunity to engage private sector in outreach on this issue. *Further Consideration*: City of Tulsa should continue to coordinate with the State AV task force to develop general AV

Policy Area	*State*	*Local*	*Comments / Further Consideration*
		For professional architectural/engineering firms, the amount is described in Title 18, Chapter 1, Section 104: must be at least $100,000 for studies, and up to $500,000 for construction projects, depending on the value. For special events, the event organizer must have at least $1,000,000 in liability coverage (Title 37, Chapter 14, Section 1408). This may apply for pilots and demonstrations. Specifically, for utility vehicles for hire (Section 147): "The holder shall comply with the requirements of Section 111 of this chapter with the following increased limits: a comprehensive liability insurance policy covering each owned, hired, and non-owned vehicle operating under his certificate in the amount of One Million Dollars ($1,000,000.00) combined single limit."	insurance/liability limits that are best suited for the context. Such considerations should track and new vehicle classifications/definitions and addition to new use cases for smart mobility solutions.
Traffic Enforcement	No specific provisions about enforcement with regard to automated vehicles. Assume all existing state traffic laws apply to AVs.	None	*Comment(s)*: All states require AVs and other forms of new mobility to follow existing traffic and safety laws, in addition to complying with Federal Motor Vehicle Safety Standards. Some states require law enforcement engagement plans before testing/deployment. *Further Consideration*: The City of Tulsa should discuss potential options with public safety officials and determine what requirements should be put into place. Convey these requirements to the State AV task force.
Shared Mobility	Regulation on transportation network companies (TNCs) at State level.	Regulation on micro-mobility (dockless e-scooters) at city-level	*Comment(s)*: Opportunity to align interests of State and communities.

Policy Area	*State*	*Local*	*Comments / Further Consideration*
			Further Consideration: The City should engage with state AV task force to promote opportunities for shared automated vehicles and exploring new opportunities for revenue generation to be reinvested into infrastructure to support smart mobility solutions, including connected and automated vehicles.
Definitions and Smart Mobility Considerations			
Common Carrier	Under Oklahoma state law: Title 13, Common carrier: Everyone who offers to the public to carry persons, property or messages is a common carrier of whatever he thus offers to carry.	No city-level definition	**Clarification Questions:** How would "safe and fit" vehicles be defined for the purposes of public transit, including for potential demand responsive partnerships and incorporation of Low Speed Automated Vehicles into transportation system? In Section 36 of Tulsa Municipal Code, what would "reasonable rate of speed" without unreasonable delay or deviation mean? In Section 42 of Tulsa Municipal Code, does this mean that all common carriers still need to provide everyone a seat, even on transit vehicles? *Further Consideration*: As part of this effort, City should continue to coordinate goals with State and coordinate with city attorney's office to evaluate questions above to continue to chart path forward that supports the City's smart mobility vision. Coordination with Tulsa Transit also recommended. Additionally, updates around liability provisions may be needed in consideration of "terms of use" used for demand responsive services should partnerships with private companies be utilized.
Low-Speed Electric Vehicles	Section 1-134.1: "Low-speed electrical vehicle" means any four-wheeled electrical vehicle that is powered by an electric motor that draws current from rechargeable storage batteries or other sources of electrical current and whose top speed is greater	No city-level definition	*Further Consideration*: Opportunity to include LSAVs within this definition. State and City should continue to coordinate and allow for deployment of automated to support common goals and interests and not limit known and unknown use cases for automated vehicles to support enhancing mobility for all people in the State.

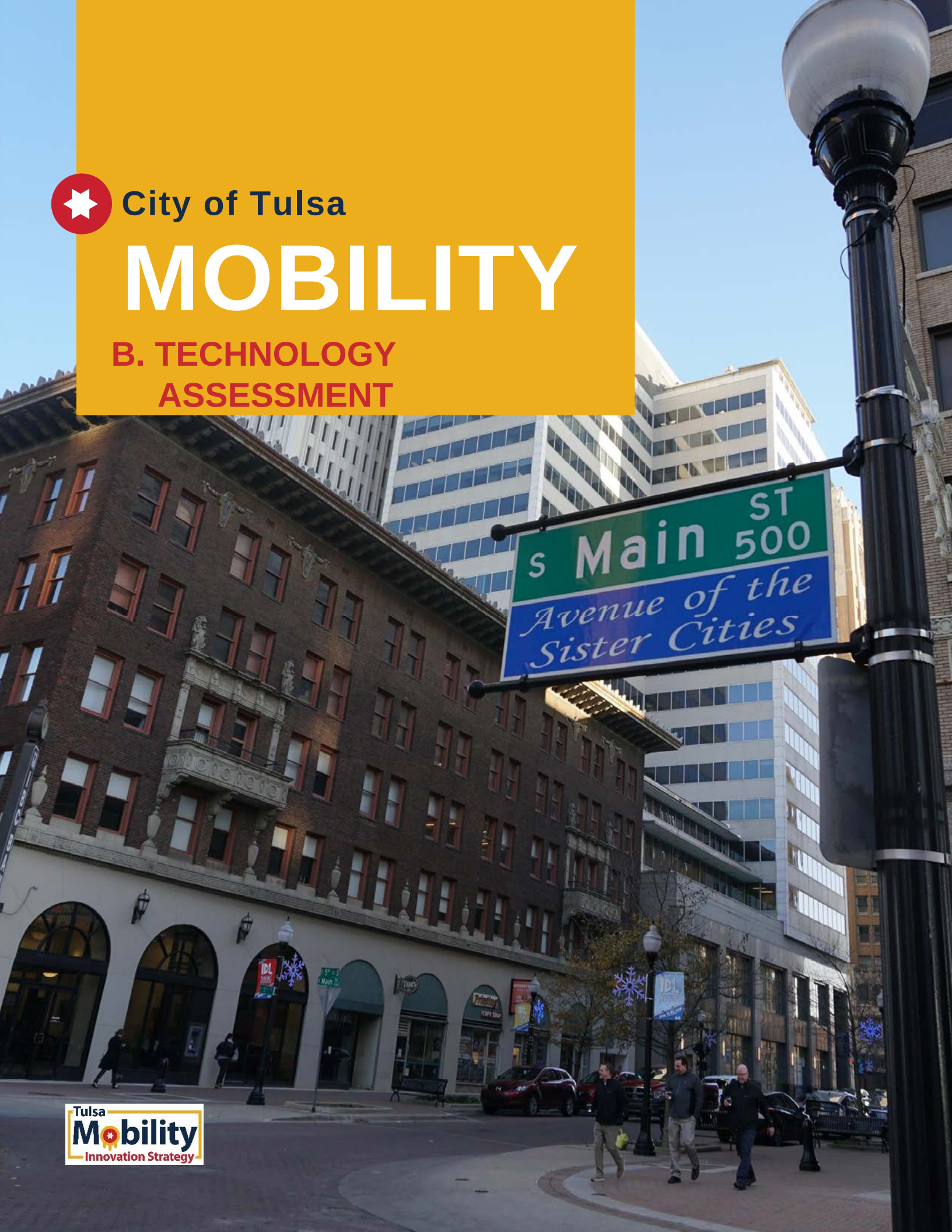
Policy Area	*State*	*Local*	*Comments / Further Consideration*
	than twenty (20) miles per hour but not greater than twenty-five (25) miles per hour and is manufactured in compliance with NHTSA standards for low-speed vehicles in 49 C.F.R. 571.500."		
Class A-C Commercial Vehicles	*Class B: Any single vehicle, except a Class D motor vehicle, with a gross vehicle weight rating of twenty-six thousand one (26,001) or more pounds, or any such vehicle towing a vehicle not in excess of ten thousand (10,000) pounds gross vehicle weight rating. This class shall apply to a bus with a gross vehicle weight rating of twenty-six thousand one (26,001) or more pounds and designed to transport sixteen or more persons, including the driver.* *Section 1-107.3: Class C Commercial Motor Vehicle-* *Any single vehicle or combination of vehicles, other than a Class A or Class B vehicle as defined in this title, which is:* *1. Required to be placarded for hazardous materials under 49 C.F.R., Part 172, subpart F; or* *2. Designed by the manufacturer to transport sixteen or more persons, including the driver.*		*Further Consideration*: It appears that larger, heavier vehicles would be classified as a Class B commercial vehicle and lighter, medium-sized (more than 16 passengers) would be classified as a Class C commercial vehicle. What ramifications does this have for rollout of new services, including in the form of automated vehicles?
Bus	Section 1-105: "Bus" shall mean every motor vehicle designed for carrying more than eight passengers and used for the transportation of persons; and every	City-level definition under taxicab regulation: "Bus shall mean a chauffeur-driven vehicle for hire, designed to	*Further Consideration*: Opportunity to align definitions that support deployment of automated vehicles to prioritize shared mobility. Clarifying definitions for use to support public transit including recent investment into Bus Rapid Transit offers chance to align with existing transportation foundations within City.

Policy Area	*State*	*Local*	*Comments / Further Consideration*
	motor vehicle designed and used for the transportation of persons for compensation. As used in this section, "Bus" shall not include a vehicle authorized for use pursuant to the Oklahoma Transportation Network Company Services Act as defined in Section 1011 of this title."	accommodate more than five (5) passengers excluding the chauffeur, classified by the manufacturer as a bus or van, not equipped with a taximeter and provided that all such vehicles are: 1. To be for hire only for travel along a fixed route which is approved by the Director in advance. 2. Of a type and configuration not generally licensed as a taxicab or limousine. 3. Not to cruise in search of patronage and not to park in any public street, or in any public or private place of assemblage soliciting patronage. This shall not be interpreted to preclude the parking of vehicles at any location while awaiting passengers; and 4. To operate at a rate fixed in advance and charged for regular travel over the approved route."	
Paratransit Vehicles		Paratransit Vehicles shall mean antique, classic or special interest vehicles for hire, limousines, physically limited transport vehicles, wheelchair transport vehicles, buses, peda-cabs, sightseeing vehicles, rickshaws and horse-drawn carriages for hire.	*Further Consideration*: Similar to reviewing definition of "bus," also opportunity to ensure existing definition allows for incorporation of smart mobility solutions to support paratransit.
Commercial Operator or Driver	Every person who operates/drives/physical control of a Class A-C commercial motor vehicle. Also, definitions for "Tillerman" and "Steerman."	No city-level definition	*Further Consideration*: In Sections 1-108 of Title 47, how may the roles of the commercial driver change in autonomous vehicles (both the "Tillerman" and the "Steerman")?

City of Tulsa

MOBILITY

B. TECHNOLOGY ASSESSMENT



Tulsa Mobility Innovation Strategy

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B1. TECHNOLOGY INTEGRATION

Transportation technology is constantly changing, as new forms of transportation emerge, but also as new technologies enable new services, new trends in transportation, and new methods for improving the level of service.

The purpose of this section is to

- Provide an understanding of the new and emerging trends and technologies in transportation
- Provide an assessment of the current state of transportation technology
- Provide an understanding of how emerging trends may affect Tulsa's planning, investments, and operations
- Provide a roadmap for Tulsa's future investments in transportation, particularly as it relates to the problem statements

B1.1 EMERGING TECHNOLOGIES

Being aware of emerging transportation technologies is important for a municipality to plan for its own future and accommodate the needs of its citizens.

It is also important to understand there is a need to balance between being proactive about technology and being reactive to technology. Being overly proactive to an immature transportation trend may mean investing time, money, and effort into a preparing for a trend that society does not embrace. Failure to anticipate an emerging trend can lead to wasted investments in the wrong technologies.

By anticipating emerging trends, there is also the opportunity to enable technologies that will benefit Tulsa - technologies that can improve safety, reduce congestion, benefit the environment, or otherwise improve the quality of life for residents.

Key Emerging Technologies

These are some of the key technologies to be aware of:

Automated Vehicles (AVs): Highly automated vehicles are also often called autonomous vehicles. Major vehicle manufacturers are investing in AV technology, and low levels of automation (such as adaptive cruise control, and automatic braking) are already widely available on the market. Some commercially available vehicles are equipped with a high enough level of automation such that the vehicle can drive with little or no human intervention under certain circumstances.

The implications of a private vehicle that can (and is permitted) to operate without a driver could possibly have a significant impact on municipalities. Such vehicles could increase the number of vehicle miles travelled by making longer routes attractive where automated driving is effective, increasing accessibility of vehicles to people who otherwise would not be able to drive a vehicle themselves or otherwise generating additional trips. In addition, many such vehicles in the population could also reduce the need for parking.

Shared Automated Vehicles (SAVs) are already on the market that can be used to provide high occupancy travel as a form of transit. Present day SAV's can typically accommodate 10-15 passengers and can operate on a fixed route without a human driver – travelling at low speed in pre-established low risk routes.

Electric Vehicles (EVs) use electric motors for propulsion. Electrical energy is stored in a battery provided directly from an external source. This technology has been around since this 19th century, but adoption rate has steadily increased over the last few years. As the price of EV's drop, forecasts for ownership of electric vehicles are estimated to reach 125 million vehicles by 2030. As widespread adoption of EVs have the potential to reduce harmful emissions, many jurisdictions are moving quickly to enable regional charging networks, EV fleet vehicles, and new land development guidelines to encompass EV charging.

New Mobility includes an emerging range of car share companies, shared bike deployments, and shared electric scooters, that allow people to adopt a wider range of transportation modes. This can also include *Transportation Network Companies (TNCs)* - companies that match passengers with drivers via websites and mobile applications. As well, many TNCs are piloting AV technology in hopes of deploying entire fleets of unmanned vehicles in the future.

Mobility as a Service (MaaS) allows for convenient multimodal travel, through a mobile application that combines multiple modes of travel into a single trip planning application. Using an application, the person can quickly compare the time, cost, and comfort of various modes of transportation, then pay and book the travel in one application. Such trips can encompass walking, biking, transit, ride-hailing services, shared scooters, and more.

Connected Vehicles (CVs) allow vehicles to communicate with other vehicles (V2V), infrastructure (V2I) such as traffic signal lights, and other (V2X) such as pedestrians, bicyclists, and more. Communication follows a specified library of protocols and standards. Dedicated Short Range Communications (DSRC) uses specific communication channels with low latency over small areas. An alternate form of CV technology, CV2X, allows for the same communications, over a mobile data network.

CV technology can operate through an interface to the driver, or directly to vehicle or infrastructure. This technology is already available as an aftermarket addition to existing vehicles and will potentially be available on the OEM market in the future. This can have a wide range of safety, mobility, and environmental applications – including transit priority installations, toll collection, cooperative adaptive cruise control, road safety alerts, and more.

Many of these technologies will combine readily; for example, most SAVs on the market are electric, autonomous, and have connected vehicle technology to integrate with traffic signals.

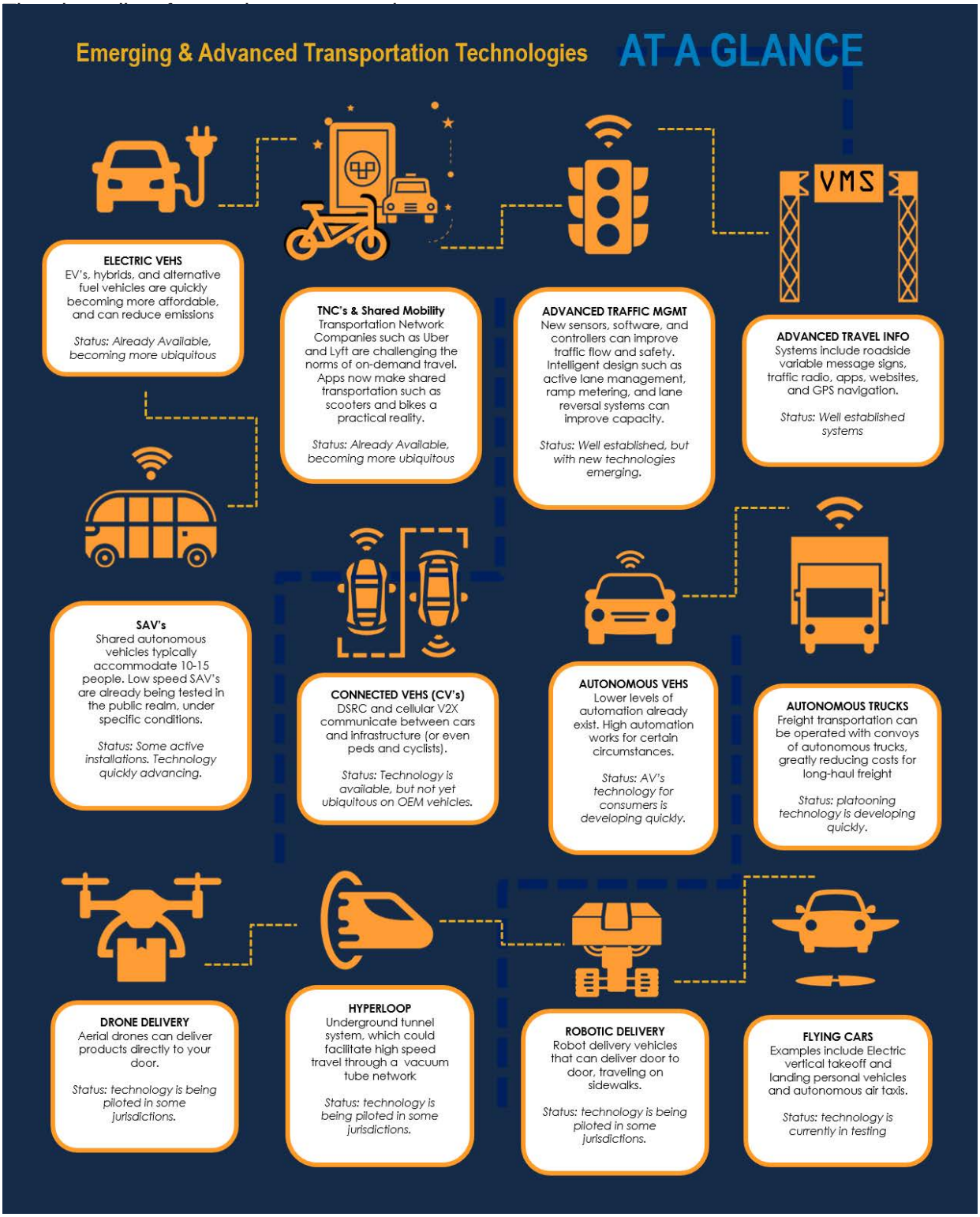


Fig 1: Key Emerging Technologies

B1.2 TRANSIT

Technology Assessment

Tulsa already has integrated substantial technology into the local transit system. Notably, the MTTA Technology Strategic Plan (2018, IBI Group) provides an existing strategic guide to technology integration.

Some of the primary goals of implementing technology within the Tulsa's transit service include

- Increasing the attractiveness of transit as a mode of transportation
- Ensuring transit provides equitable services to people of different socioeconomic backgrounds
- Ensuring transit meets the needs of accessibility
- Ensuring reliable and dependable services
- Improving safety and security on board Tulsa's transit system

The MTTA Technology Strategic Plan (IBI Group, Nov 2018) is an existing document that guide's MTTA's technology strategy and phased implementation.

The technology plan provides timelines from 2019 to 2023, as well as key recommendations for each year.

Some notable recommendations from this plan include:

- Mobile payment deployment by 2019
- Explore FLEX alternative in microtransit, enhanced customer tools in new mobility options, upgraded fareboxes, by 2020
- Shared mobility integration by 2021, and continued upgrading of fareboxes, customer tools for new mobility options, and a smartcard system

TECH	STATUS	BENEFIT
Electronic Fare Boxes	★★★	Equity
Real Time Information • Text message notifications • Multimodal mobility app in development • Travel info station displays at Aero stations	★★★	
Public Wi-Fi on Buses • Retrofits and Wi-Fi on new bus acquisitions	★★☆	
Schedule / Dispatch Software	★★★	
Fixed Stops	★★★	
Transit Camera Security	★★★	Safety
Auto Braking Systems	★★★	
Kneeling Buses	★★★	Accessibility
Automated Announcements	★★★	
Transit Signal Priority • Currently on 2 key corridors • Planned upgrades	★☆☆	Efficiency

Fig 2: Transit Tech Assessment

Today's Tech

Some of the technologies that have already been integrated within Tula's transit system are shown in Figure 2 above.

Some of the key technologies needed to keep Tulsa's transit system competitive are already in place. For example, moving towards electronic fare boxes, makes this mode of transport competitive with other alternative transport through enabling a convenient method electronic payment.

Travel information, real time apps, fixed stops, and scheduling software all provide higher assurance of the reliability and availability of transit, on par with alternative modes. On-board wi-fi provides additional convenience, particularly to people who have little or no access to internet on their mobile devices.

In addition, Tulsa is already working on integrating new technologies in its transit system including:

- Multimodal mobility apps / Go Pass
- Mobile fare payments
- Public wi-fi on new bus acquisitions
- Traffic signal priority on 2 key corridors
- Fiber installations on key corridors

Particularly, the multimodal mobility apps will allow transit to be a convenient and integrated form of transportation – allowing it to be a convenient portion of the travel in the context of other competing and popular methods of transport. Integration of transit signal priority will allow for transit vehicles to maintain schedule reliability in heavy traffic and can even provide a competitive advantage for Transit over less sustainable transportation methods.

Traffic signal communications is one of the fundamental cornerstones to a quality transit corridor. Even low bandwidth communications will allow for traffic signal coordination to work at peak optimization by minimizing clock drift within traffic signals.

A recent traffic optimization project in Calgary, Canada, showed clock drift on a coordinated corridor increased travel delays by 20-30 percent in some sections, when central communications were lost for several months despite the signals being coordinated.

Simply re-establishing communications allowed the signal controllers to receive daily central management clock updates, which allowed traffic to receive the maximum benefit of synchronized travel between intersections.

Future Planning

In terms of transportation technology integration, what else can Tulsa do to prepare its transit system for the future?

To ensure that transit is an attractive and sustainable form of transportation, continued traffic signal improvements may be one of the top potential improvements – helping to maintain public transit as a preferred transportation mode by ensuring that transit corridors receive high quality traffic signal service to meet the public's desire for reliability and schedule adherence even as the population and traffic demand grow.

Basic traffic signal operations maintenance can be the least expensive method of improving performance for a transit corridor, and should always be the first consideration, prior to more expensive measures:

1. Field operations and signal controller programming must be reviewed on a regular basis.
2. vehicle detection hardware must be checked to ensure the detection is working properly along the route.
3. Signal controller clock drift can be mitigated using central communication or GPS time clock synchronization.

Transit corridors can also sometimes benefit from having expert independent review of traffic signal controller programming. This ensures that traffic signal programming methodology is being operated at maximum

efficiency. This is particularly important where transit signal priority is in place.

Transit Priority helps to significantly improve travel time for transit vehicles, by providing additional green time for a particular movement (e.g., left turn lane, or through movement), only when a transit vehicle is present. Some transit signal priority systems have been implemented in Tulsa; transit signal priority programming tends to be specialized – some independent expert review is recommended for such systems.

Where transit signal priority measures are insufficient, queue jump can be considered under certain circumstances. This is a more expensive measure than basic transit signal priority, as it requires reconfiguration of intersection geometry to be dedicated to the transit vehicle, to allow the vehicle to proceed in advance of other traffic. Not all intersections will be conducive to this measure, but when applied, it can result in significant travel time delay reduction for transit vehicles.

Traffic signals along transit routes should be a higher priority for communications, by fiber or by wireless/mobile communications. Communication allows for more robust traffic signal programming and control. Figure 3 shows traffic signals without communications, relative to bus routes.

Longer corridors can benefit from traffic signal communications and signal progression along a corridor. Locations with multiple bus routes may also be a priority.

SHARED AUTOMATED VEHICLES

Cities across North America have implemented trial operations of SAV's, providing communities with a way to experience this new technology, and gain feedback on user acceptance.

Implementations of SAV's are typically low speed applications within a shorter route within mixed traffic or on private dedicated roadways.

A few notable cities that implemented SAV trials include

- New York, NY
- Orlando, FA
- San Ramon, CA
- Denver, CO
- Punta Gorda, FL
- Beaumont, Canada
- Montreal, Canada

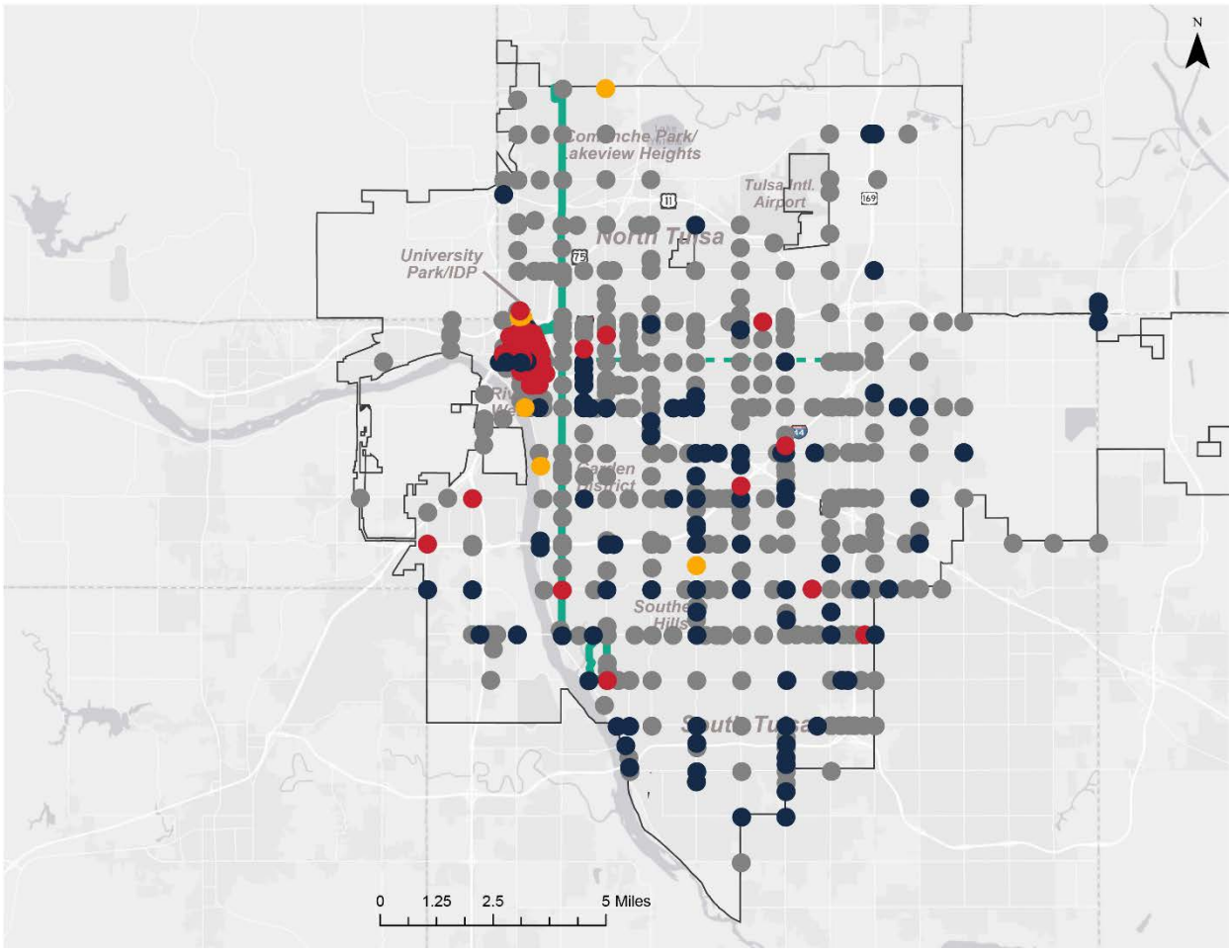
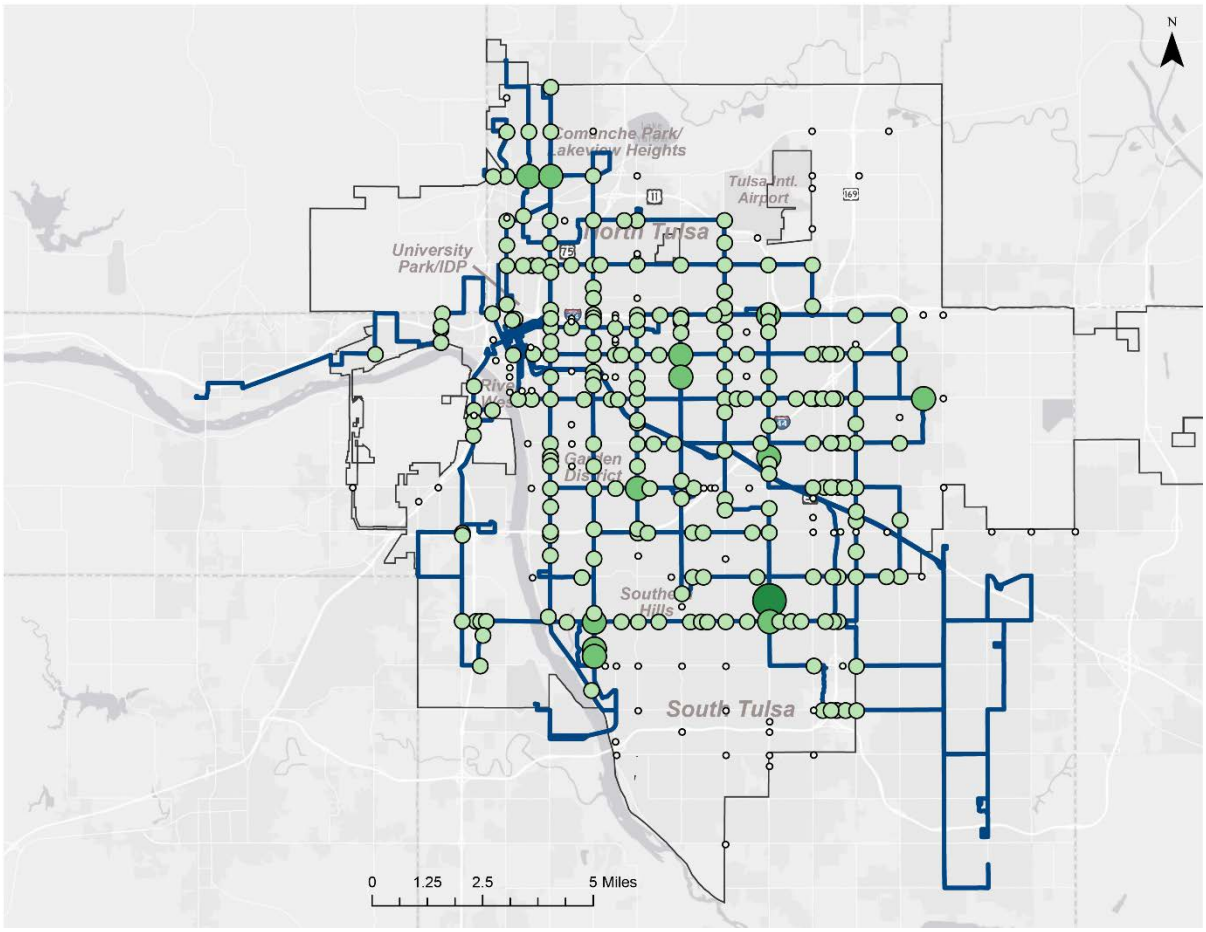


Fig 3: Location of BRT & Traffic Signal Lights



Transit Routes:

Tulsa Transit Route

Signal Lights – by # of overlapping Transit Routes:

- 0
- 1-2
- 3-4
- 5-6

Fig 4: Location of Bus Routes – Traffic signal lights without communications on bus routes

B1.3 VEHICLE TRAFFIC

VEHICLE TRAFFIC TECHNOLOGY ASSESSMENT

The City of Tulsa's traffic network primarily relies on traffic signals as the primary and fundamental technology that influences vehicle traffic mobility and safety for vehicles on the roadways.

Generally, traffic congestion in Tulsa is relatively light compared to other major American cities. Using crowdsourced data, TomTom ranks Tulsa as #70 out of the 80 worst congested cities in the United States; with a 13 percent typical congestion delay (delay attributed to congestion). By comparison, Colorado Springs and Minneapolis have a similar population to Tulsa, but have a significantly higher 17 percent congestion delay.

During peak hours, the highest delays are primarily on the freeway ramps.

Today's Tech

Some of the technologies that have already been integrated within Tula's traffic network include are shown in Figure 4 below

TECH	STATUS	BENEFIT
Centralized Traffic Management • TMC w/ centralized ODOT connectivity o ATMS Software (Centracs) communicates to ~200 traffic signals with planned expansion o Some optical fiber + some wireless; increase planned o PTZ cameras • Real-time data o INRIX contract o StreetLight data contract	★ ★ ★	Efficiency, Safety
Traffic Signals • Advanced Transportation Controllers • Fully actuated traffic signals (outside CBD) o Video, loop, and radar-based detection • Planned upgrades to emergency pre-emption (infrared Opticom)	★ ★ ☆	Efficiency, Safety
Safety • 1 radar activated speed advisory sign • Rapid Rectangular Flashing Beacons	★ ☆ ☆	Safety, Equity
Parking • Park Mobile App for mobile payments • Planned toll tag technology for airport/downtown parking garages	★ ★ ☆	Efficiency
EV Charging • Electric Vehicle charging stations	★ ★ ☆	Environment

Fig 5: Vehicle Traffic Technology Assessment

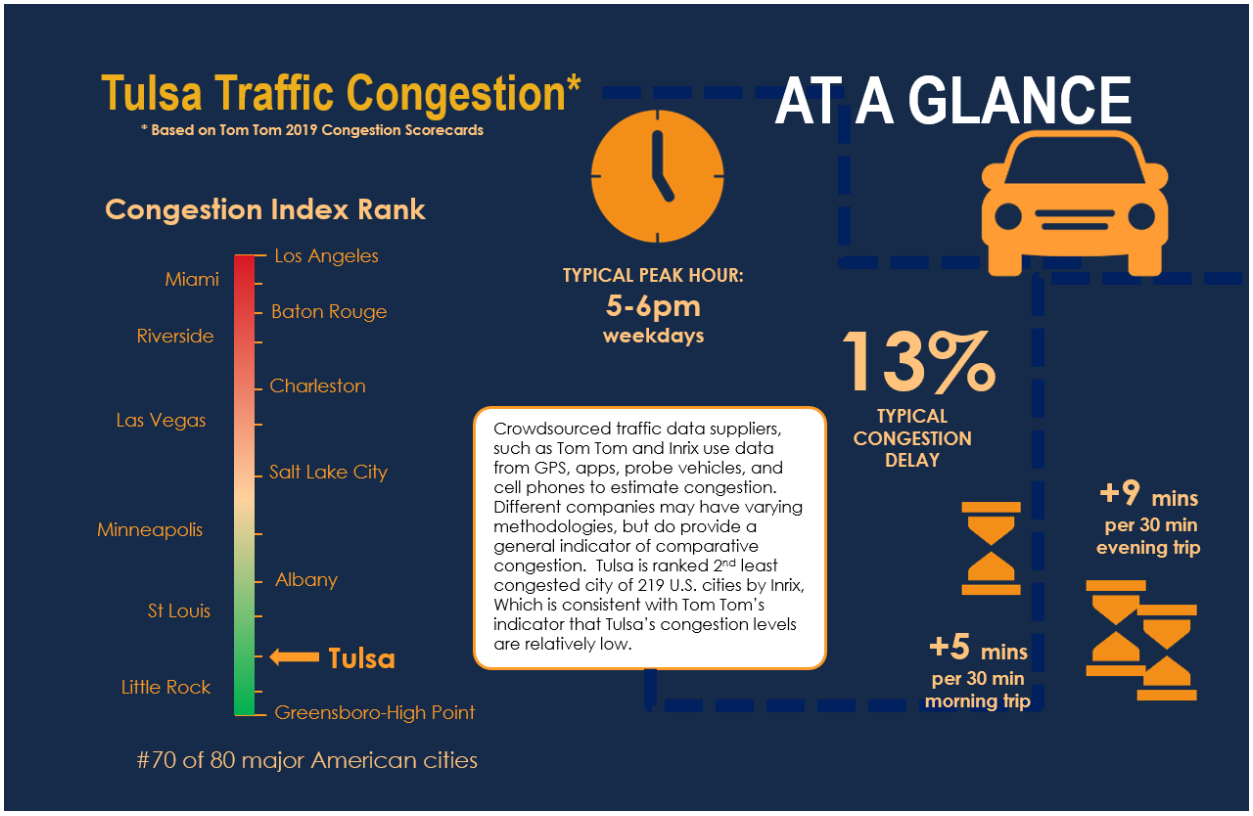


Fig 6: Traffic Congestion in Tulsa

Having the fundamental communication systems and hardware in place for critical routes, as City of Tulsa has done, allows for increased adaptability to population growth. With centralized control and connectivity, basic infrastructure is in place to accommodate changes in traffic volumes and shifts in technology or transportation modes.

With the ability to detect vehicles, observe traffic, and view crowdsourced traffic congestion data, City of Tulsa also has the fundamental tools for planning, analyzing changes, and troubleshooting systemic traffic congestion issues.

In addition to the above, the City of Tulsa is already moving towards additional technology to prepare for the future:

- Planned implementation of fiber and wireless communication to a higher number of traffic signals
- Expanding ATMS connectivity
- Planned upgrades to emergency pre-emption hardware
- Planned upgrades for transit signal priority
- Accessible pedestrian push buttons on all new traffic signals
- Toll tag technology for airport/downtown parking garages

Although traffic congestion in Tulsa is relatively low compared to many other

similar jurisdictions, this proactive approach to technology will enable the city to maintain a high level of service for vehicles.

As Tulsa continues to grow, traffic congestion may increase, and new solutions may be needed to improve efficiency of the

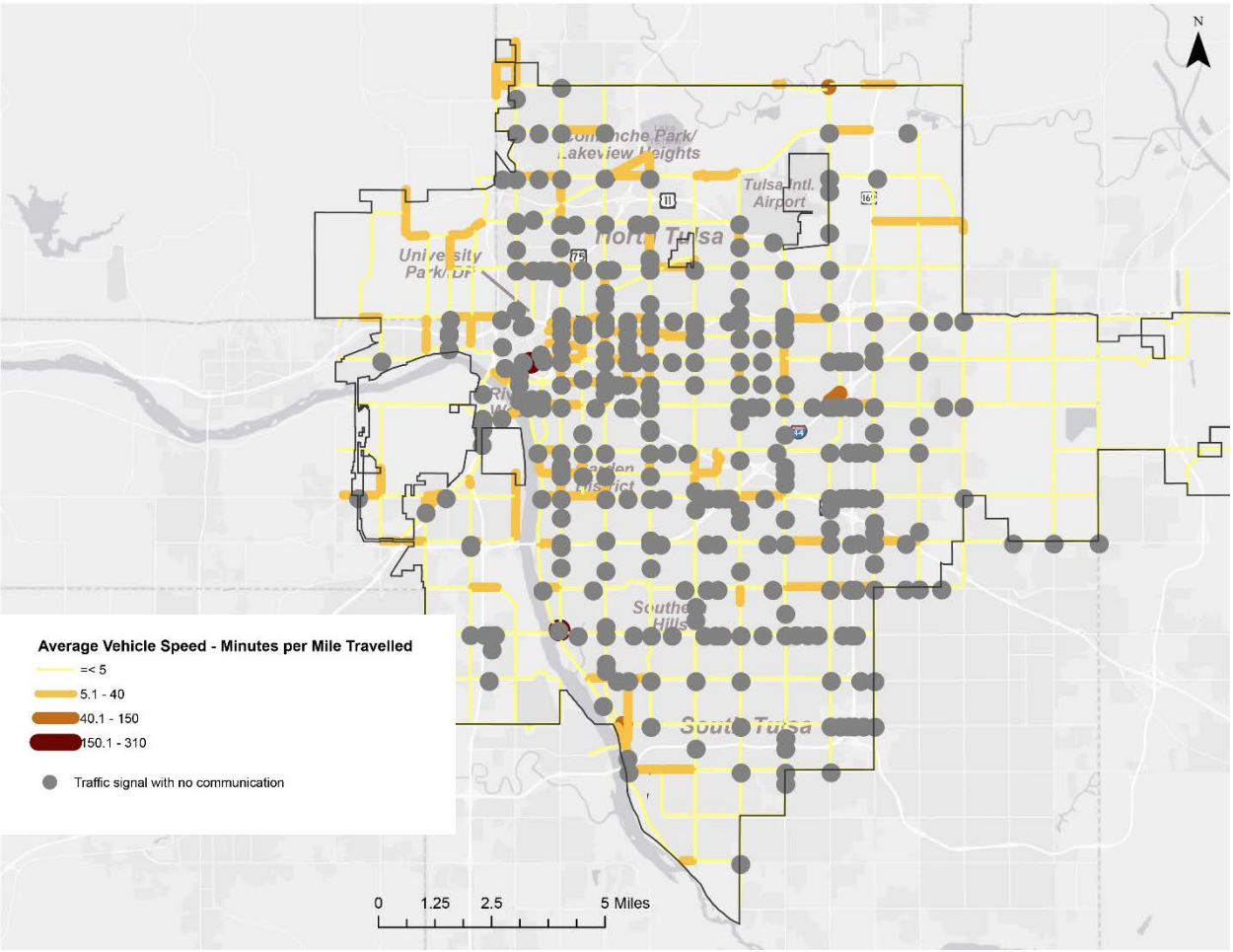


Fig 7: Traffic Signals without communications vs segments by speed

As well, the high level of collaboration between IT, the traffic engineering department, and transit authority, show a high level of cooperation that allows for improved service that benefits all transportation modes and allows for high adaptability for changing technological needs.

Future Planning

network. In addition, changing technologies of the future may require accommodation of new consumer technologies, and changing methods of transportation.

As cities grow, signalized intersections may decrease in performance; altering traffic signal timing plans to accommodate changing traffic patterns will be necessary. At some point, it may be efficient to bring in

subject matter experts to evaluate problematic intersections; advanced traffic signal technologies can be a low-cost solution to future congestion issues:

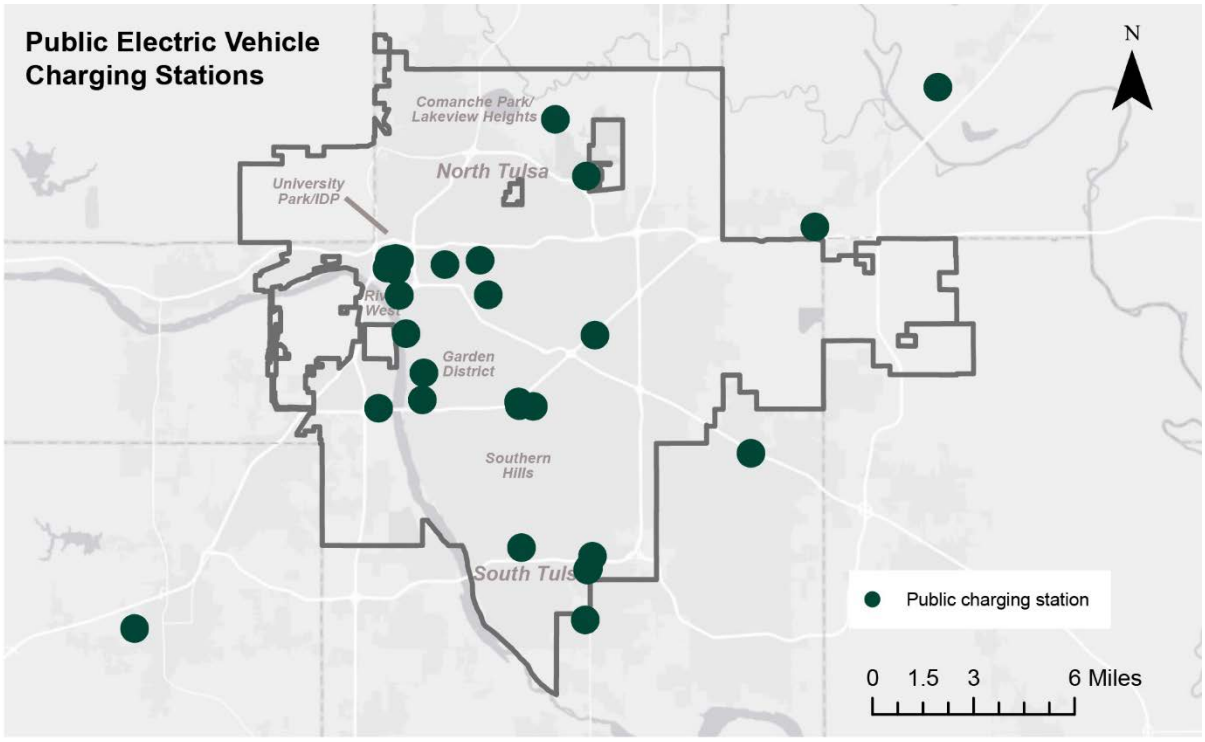
- Advanced signal performance measures analysis can analyze traffic signal data, and help diagnose software, hardware, and programming issues. Combined with a signal programming expert, significant improvements can sometimes be achieved without new hardware.
- Experienced transit signal priority programing experts can evaluate and optimize transit routes, by optimizing traffic signal controller programs.
- Some new detection technologies can be applied to optimize problematic intersections, by providing critical vehicle detection data beyond that of standard stop bar detection systems. Advanced detectors, or turnbay overflow detectors can provide the traffic signal controller with additional data to further optimize actuated intersections.
- Traffic adaptive and traffic responsive systems are useful in areas with coordinated traffic signals, where traffic flows occasionally or frequently experience high fluctuations in traffic volumes. For example, a software-based traffic responsive system could greatly improve traffic signal adaptability to a corridor near a shopping mall or large sports arena

Other potential technologies that could be explored to provide high level of service to the network include. Are provided below. Some technologies and infrastructure can be expensive to implement. Selection of such projects can be based on analysis of feasibility, cost, and benefits.

- Travel information variable message signboards; to provide real time information on road conditions, route closures, and traffic delays
- Portable radar equipped speed limit advisory signs, to help reduce speeding in problematic areas.
- Automatic pedestrian detection systems, providing improved services to pedestrians – and provide increased accessibility
- Dynamic parking wayfinding guidance: to reduce traffic congestion caused by traffic looking for parking
- Active lane management, ramp metering, and variable speed limits could be explored in conjunction with state highway authorities to decrease ramp congestions

In addition, preparing for emerging technologies and upcoming trends will help to encourage new transportations modes that can improve safety, mobility, and provide emission reduction.

- Electric Vehicles: Tulsa already has begun preparing for this emerging technology with EV charging stations. As EV adoption is expected to continue to grow, monitoring the supply and demand of EV charging infrastructure is necessary. As prices of E's are expected to reach parity with internal combustion engine vehicles by 2025, capital cost and operating cost will make it economically beneficial for families to own an EV. However, note that families who live in multi-family residential housing will have less access to EV charging; retrofitting parking garages for EV charging may be a financial impediment to owning an EV, despite the cost savings for EV ownership. This can increase the disparity of higher income and lower income citizens. Consideration should be given to reviewing the requirements when building new parking facilities (both public and private) to ensure they are pre-wired for future EV charging facilities, but particularly for multi-family dwellings.



TECH	STATUS	BENEFIT
EV Charging • Electric Vehicle charging stations	★ ⯪ ☆	Environment

Fig 8: Public EV Charging Stations

- Connected and Automated Vehicles: As automated vehicles begin to emerge; it is anticipated they will make use of Connected Vehicle technology for communication to infrastructure and other vehicles. An initial pilot project could involve installing CV technology on a limited number of traffic signals, with functionality such as Signal Phase and Timing (SPaT), MAP messages, Basic Safety Messages, and red-light violation warnings, pedestrian detection, and more.

CONNECTED VEHICLES

The world market for CV technology is projected to reach $225B by 2025.

Connected Vehicle pilot projects and testbeds provide municipalities the opportunity to work with this technology and allow auto manufacturer's the ability to test CV applications in a real world setting. This technology can help improve safety, mobility, and even have environmental benefits. It can also pave the way for use of CV within Automated Vehicles. Notable North American CV projects include:

- THEA CV Pilot: Tampa Hillsborough Expressway Authority equipped 10 buses, 8 streetcars, and 1000+ volunteer vehicles with CV technology
- ACTIVE-AURORA: Canada's first CV testbed in Edmonton, AB, featuring 42 roadside units and a state of the art research and application development facility
- City & County of Denver: $12M program to reduce traffic congestion includes CV technology on 1500 fleet vehicles
- GENIVI-Las Vegas CV pilot: Targeting areas where safety can be improved, such as alerts or warnings for bus stops, high risk areas, speeding, and incidents where traffic is stopped.
- NYC CV Pilot: Plans to install 300+ Roadside Units in Manhattan, and On board units in approximately 8000 vehicles, including 700 MTA buses, 5000 city vehicles, and 1000 taxicabs.

B1.4 ACTIVE MODES

Tulsa's infrastructure supports of active modes, multimodal transport, and new mobility modes. These modes of transportation can support exercise, quality of life, and environmental sustainability, while also providing low-cost transportation options to people of all socioeconomic means.

Tulsa is the 34th "most walkable" city, of 141 U.S. cities with a population over 200,000

as ranked by Walk Score

These forms of transportation often provide excellent options within a shorter range but need to be part of a broader public transportation system to allow citizens to have an attractive alternative to car ownership.

Today's Tech

Figure 7 shows some of the things that are already in place to support active modes and new mobility in Tulsa.

Noting Figures 8 and 9, although these options are present, there is a lack of distribution of the infrastructure, such that the bicycle lanes, bike share, and shared scooter infrastructure are concentrated in a small area, and do not provide a viable transportation option to much of Tulsa.

TECH	STATUS	BENEFIT
Multi-Use Paths	★☆☆	Environment, Equity
Protected Bicycle Lanes	★☆☆	Environment, Equity, Safety
Shared scooters	★☆☆	Environment, Equity
Shared bicycles	★☆☆	Environment, Equity
Multimodal mobility app	★☆☆	Environment, Equity
Accessible pedestrian push buttons	★★☆	Accessibility
Rapid Rectangular Flashing Beacons	★★☆	Safety, Equity

Fig 9: New Mobility & Active Mode Assessment

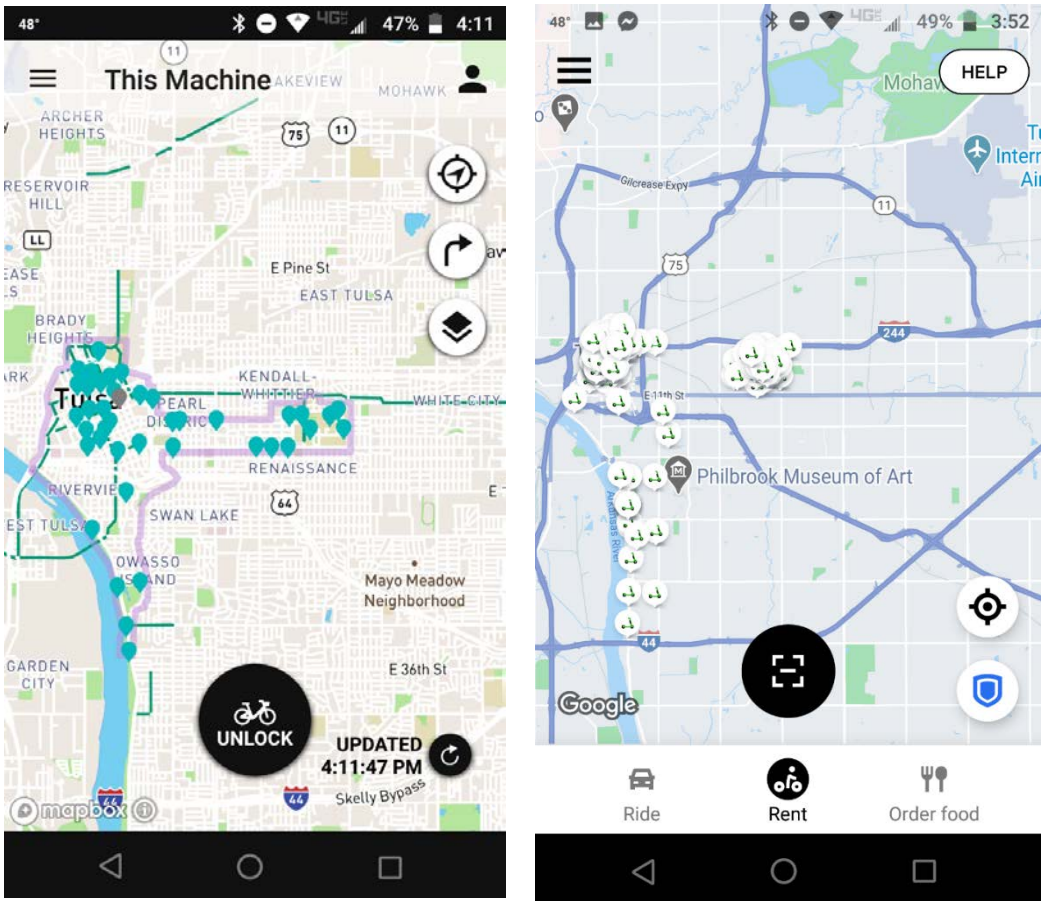


Fig 10: Sample of Existing Distribution of This Machine (shared bikes) and Lime (shared e-scooters)

Future Planning

Increasing attractiveness of active modes and increasing options for new mobility modes will help provide options for transportation that improve equity, environmental benefits, and quality of life.

Some ideas that can be explored to provide improved active mode and new mobility options:

- Car share and car-share parking policies, to attract car-share companies and establish the rules for how their curbside management
- Overhead pedestrian activated lighting systems can help illuminate crosswalks if nighttime safety is a concern
- Portable speed radar activated signage help reduce speeding in playground zones and residential areas. These systems can be moved to new areas periodically, to improve driver compliance
- Pedestrian detection technologies can be explored that do not require pushing buttons; pedestrian detection can replace the need for pedestrians to push pedestrian buttons, and even detect those

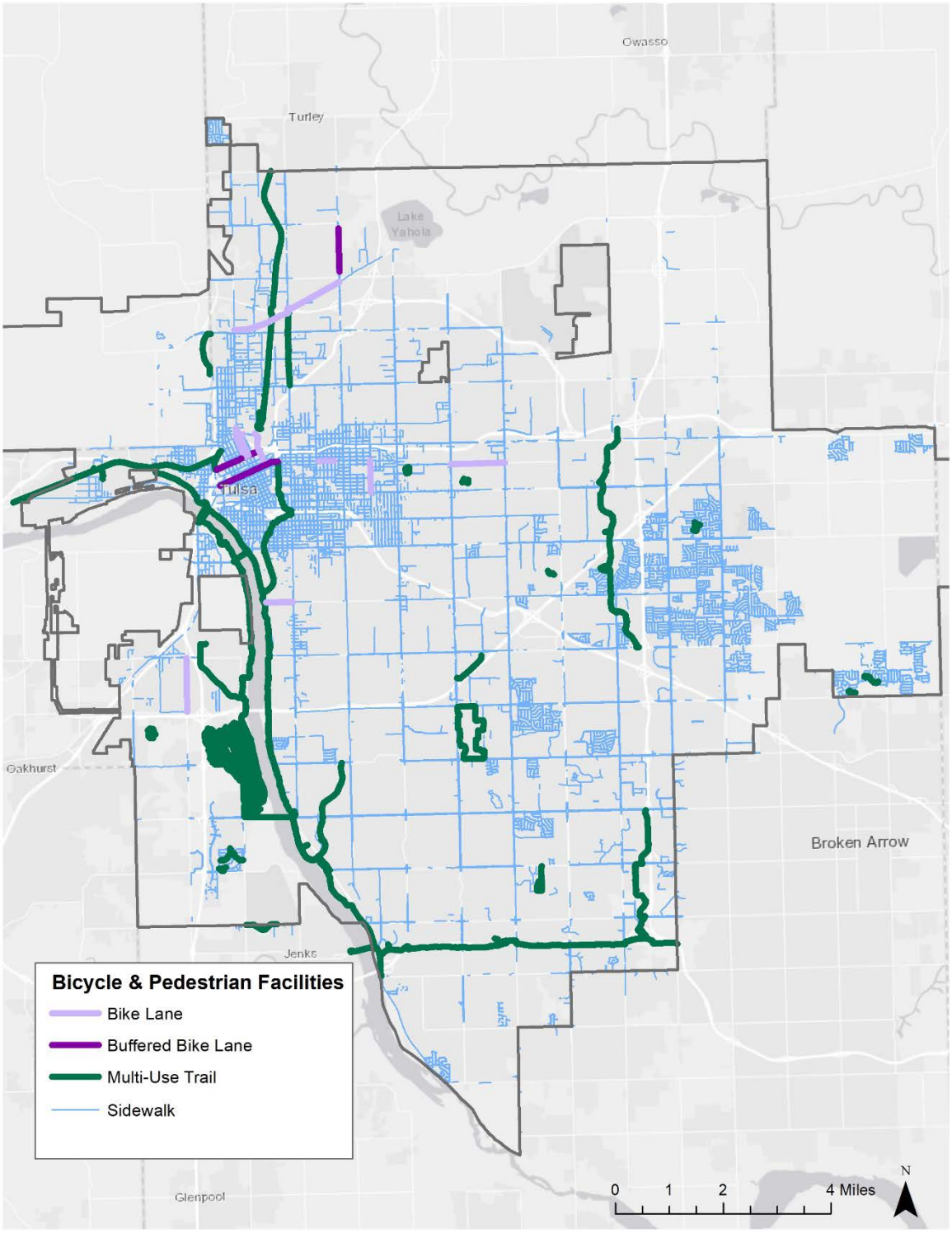


Fig 11: Bicycle and Pedestrian Facilities

to ensure the pedestrian walk time is sufficient for the pedestrian

- A connected vehicle pilot project can be used with pedestrian mobile applications to provide visually impaired pedestrians improved experiences with crossing streets, such as letting them know where they are, that the pedestrian sequence has been activated, and even if they've strayed outside the designated crosswalk
- Encourage and enable shared transportation technologies in areas of Tulsa that can benefit from equitable transportation services

B1.5 INFORMATION TECHNOLOGY

The City of Tulsa's Information technology services provide the backbone of the transportation technology infrastructure, allowing for communication and control field devices.

The IT Department collaborates closely with the Transit and Traffic services to provide technology integration.

Today's Tech

The existing technology is based on a substantial IT infrastructure complementary to the transportation system as shown in Fig 12, below.

Future Planning

Some considerations for future planning include

- Continued support of equitable broadband internet access
- Enabling testing and implementation of 5G
- Review and improvement of software development processes

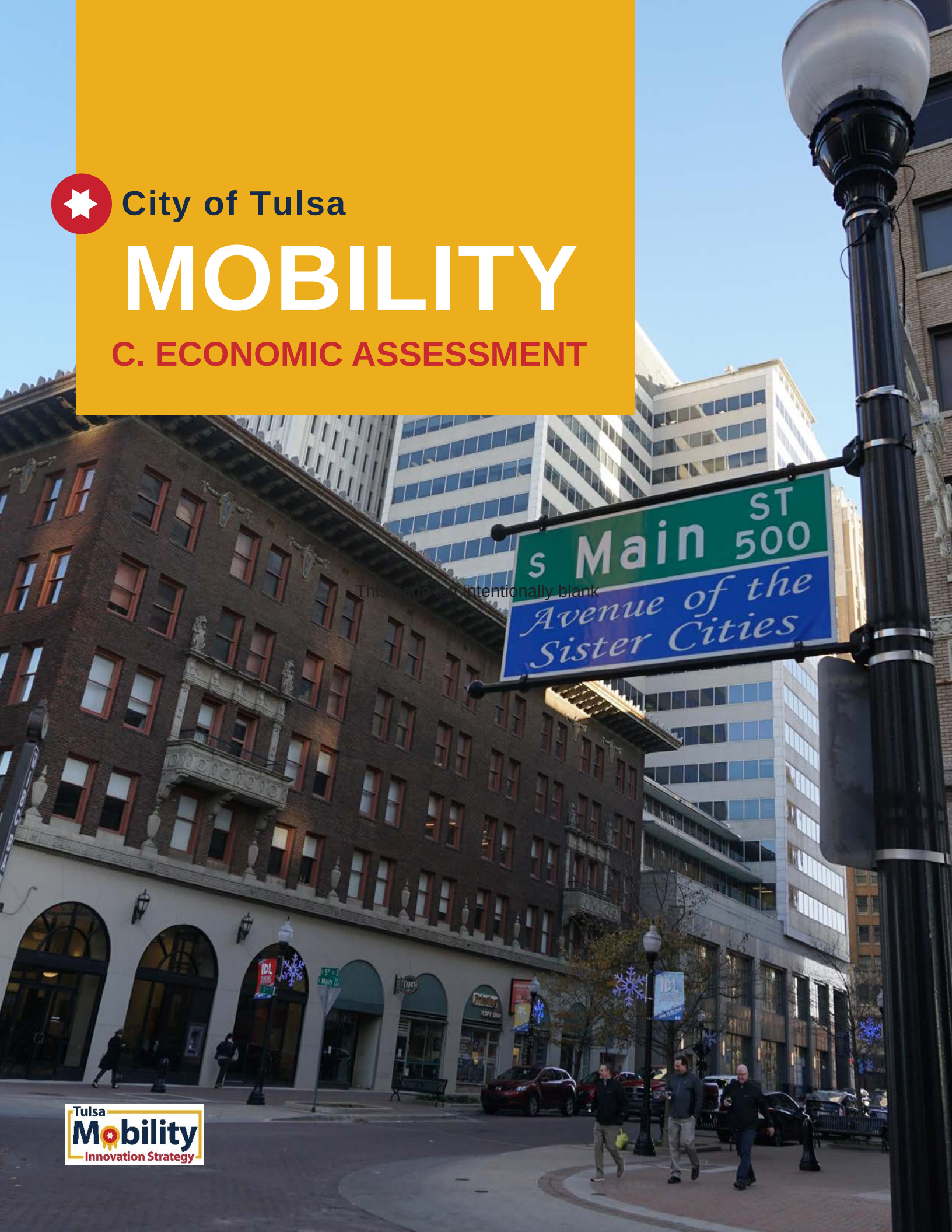
TECH	STATUS	BENEFIT
Traffic Management Center, with redundant data comms ring	★★★	Safety, Environment, Equity
TMC Communications at ~200 traffic signals	★★☆	Environment, Equity, Safety
Privacy policy for traffic video surveillance	★★☆	
Statewide radio network	★★☆	Equity
250 miles of fiber	★★☆	Environment, Equity, Safety
Open data sharing platform for online traffic data counts	★★☆	Equity
Public wifi on board buses	★★☆	Safety, Equity
Improving internal software development process	★☆☆	

Fig 12: Information Technology Assessment

City of Tulsa

MOBILITY

C. ECONOMIC ASSESSMENT



Tulsa Mobility Innovation Strategy

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C1. INTRODUCTION

This analysis examines the industry connections of several key industries involved in the industries related to Mobility Innovation including new mobility/autonomous vehicles/electric vehicles. More specifically, we focus on industry-to-industry buying and selling relationships, the "value chain," for sectors of the economy that are directly tied to businesses, infrastructure, and systems supporting or being supported by the Tulsa Mobility Innovation Strategy. The process of identifying specific economic development opportunity begins with data-driven quantitative analysis of industry value chains.[1] We start with a single "core" industry that makes significant local economic contributions, and then identify the industries from which the core industry is most likely to buy and sell.

The second step in the process is to evaluate the current labor supply in the Tulsa Metropolitan Region to identify strengths and weaknesses related to industry skill requirements. If the local labor market is substantially lacking in key skills, identified by current occupation matrices, we will consider the magnitude and breadth of the gaps. If it is unlikely that Tulsa can, in the near term, provide a potential firm with the requisite skills in the labor force, that industry will be dropped from further consideration. We build our analysis on the question: Are there sufficient workers in the Tulsa region with occupational skills to support the attraction of a new 300-employee firm? Our broad assessment of the Tulsa labor market suggests that for most industries identified in this analysis, there is a viable labor market that exists or could be readily developed to facilitate business attraction and development. We also identify Equity Occupational Opportunities that offer the potential for increasing opportunity diversity for Tulsans. These are good-paying jobs that require a high-school diploma or equivalent and perhaps some training that would support new growth sectors related to Mobility Innovation and support the geographic diversity of employment opportunity across the region.

The third step will be to further examine the screened set of inter-related industries and make a qualitative assessment of the degree to which the Tulsa market has the innovation and entrepreneurial eco-system to attract new or enhance existing firms and/or develop home-grown businesses to meet the opportunities identified in this analysis. The final component of this analysis will include a list of exemplar firms representing the identified industries/clusters.

C1.1 VALUE CHAINS

IDENTIFYING INTER-INDUSTRY LINKAGES

The value chain model used here attempts to account for all the buying and selling between all industries in the U.S. economy. [2] In an ideal world this model would be based on global buying and selling patterns, but those data are unavailable. However, the U.S. economy serves as a

[1] By contrast, a 'supply chain' analysis would examine individual firm to firm relationships that require extensive qualitative research and firm cooperation.

[2] The model was developed by Dr. Edward Feser while a professor of urban and regional planning at the University of Illinois Urbana-Champaign. It is based upon the U.S. Census Bureau's Economic Census and Benchmark Input-Output data developed by the U.S. Bureau of Economic Analysis.

reasonable proxy because it is well developed and a deeply integrated economy. Once determining these inter-industry connections, we can then apply regionally specific data[3] to better identify regional economic strengths, emerging opportunities, and the gaps that might be filled through the economic development process. This knowledge will help inform strategies to grow and strengthen the region's targeted industry clusters.

For each of the core industries we will present a value-chain diagram (or "value-chain map"). These diagrams lay out each core industry's *forward linkages* (sales made by the core industry, or market opportunities) and *backward linkages* (purchases made by the core industry, or supplier opportunities).[4] The linked industries identified in these diagrams do not represent all of the linkages. Instead, they focus on those relationships that are most extensive in terms of the size of the transactions and "close" in terms of how directly the core industry interacts with other U.S. industries through either a buying or selling relationship. In determining the most significant linked industries, our model considers three factors:

- The directionality of the flows. Are the linkages forward or backward linkages?
- The structure of the flows. Who does the core industry buy from, or sell to, most directly?
- The volume of flows. What industries does the core industry buy from, and sell to, the most?

Figure A1.1 provides a guide for reading the value-chain diagrams that will follow in the report.[5] The colored boxes indicate how concentrated each linked industry is in the local economy. The up or down arrows in the linked industry boxes depict whether an industry is growing or declining regionally. The colored arrows leading to and from the core industry indicate the flow of trade–whether the core industry is purchasing or selling within the key sector. The purpose is to identify industries and firms that have extensive trading relationships and are experiencing growth in the Tulsa metro area. Linked industries that are growing or highly concentrated within the region reinforce the potential strength of the core industry and bode well for efforts for further development of the core industry. Conversely, where linked industries are not present or not heavily concentrated, there may be gaps that need to be better understood to help expand the core industry.

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[3] Unless noted otherwise, the analysis uses data provided by Chmura Economics JobsEQ (www.chmuraecon.com). Chmura Economics is a nationally recognized proprietary data vendor based in Richmond, VA. Their data combines U.S. Bureau of Labor Statistics employment payroll data from its Quarterly Census of Employment and Wages and then provides estimates for data cells that BLS privacy standards do not allow it to disclose publicly.

[4] This approach does not account for the ultimate consumer of these goods (final demand), therefore if an aircraft manufacturer sells jets to the Department of Defense, "Government" would not appear as a forward linkage.

[5] It should be noted that the core industry often buys and sells with other firms in its own industry. As a result, the diagrams regularly show that core industries are often closely linked to themselves.

Figure A1.1: Guide to reading value-chain diagrams

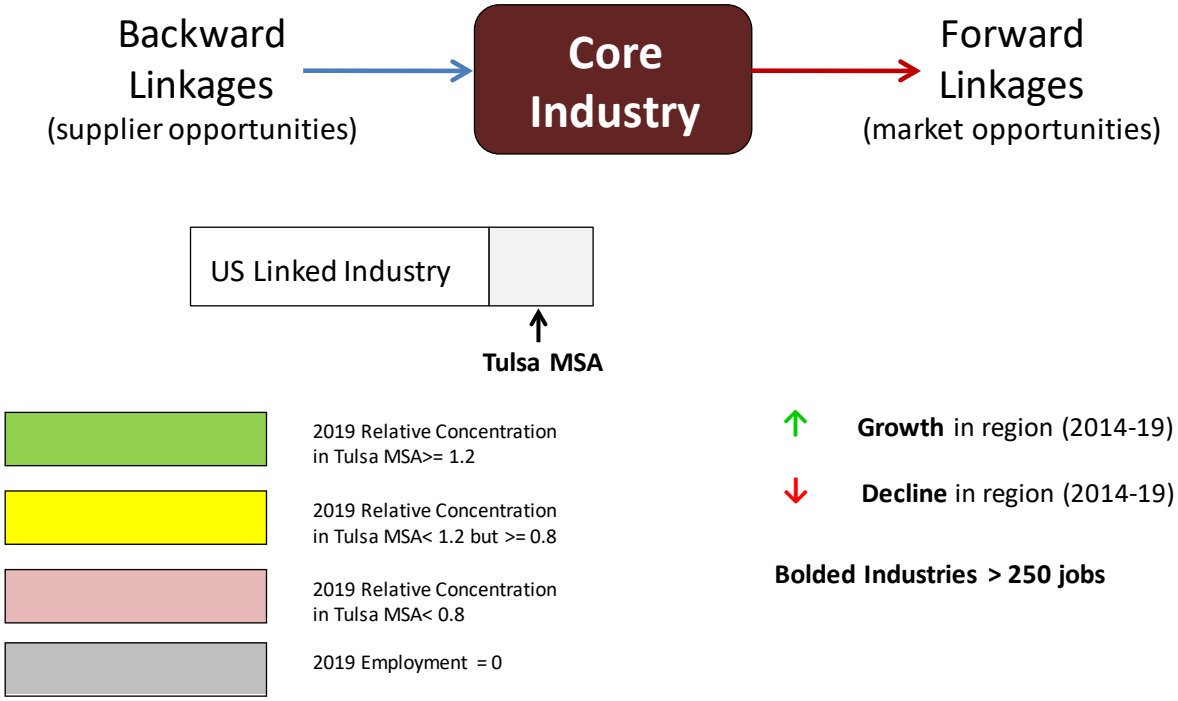


Table A1.1: Core industries

NAICS	Industry	Jobs (2019)	LQ (2019)	Annual Job Growth (14-19)	
				Tulsa MSA	USA
5413	Arch., engineering, & related services	5,375	1.20	0.7%	1.8%
336413	Aircraft parts & auxiliary eqpt. MFG	1,710	5.46	9.8%	1.4%
334513	Industrial process variable instruments MFG	692	3.96	-1.2%	0.3%
334511	Search, detection, & navigation instruments MFG	401	1.11	4.7%	1.3%
54162	Environ. & other tech. consulting services	199	0.73	-7.2%	1.1%
335312	Motor & Generator MFG	180	1.72	-1.7%	-0.8%

Source: Chmura Economics, JobsEQ

The value-chain diagrams are not intended to map the connections between every firm within an industry, but rather to paint an overall picture of how one core industry connects to related industries. The focus is on linkages and what kinds of industries are more closely networked with the core industry. It should also be noted that if an industry does not appear on the list, it does not mean that those relationships do not exist. It does, however, suggest that strong connections and extensive business relationships are less common and less direct.

MAPPING TARGET VALUE-CHAINS

There is no individual NAICS code that touches upon new mobility/autonomous vehicles/electric vehicles. Rather, these sectors incorporate many different technologies (e.g., motors and generators; aircraft parts; search, detection, and navigation instruments, etc.), and has a wide variety of applications (e.g., transportation, remote sensing, etc.). To better understand how this emerging industry fits within the broader economy, we examined the value-chain linkages of six

industries related to new mobility/autonomous vehicles/electric vehicles. These 'core' industries are identified in Figure A1.2.

Four of these industries involve the manufacturing of key components of autonomous vehicles including—aircraft parts and auxiliary equipment manufacturing; industrial process variable instruments manufacturing; search, detection and navigation instruments manufacturing; and motor and generator manufacturing. Two other industries include firms that are apt to use these technologies—architectural, engineering, and related services, and environmental and other technical consulting services.

The economic performance of these 'core' industries in the Tulsa metro area varies by industry.

- In two of these six industries—*aircraft parts and auxiliary equipment manufacturing* and *search, detection and navigation instruments manufacturing*—the Tulsa metro area demonstrated clear strength, as both industries had above-average concentration of employment and job growth (2014-2019) occurred at a faster rate in the Tulsa metro area than it did nationwide.
- In three other industries, the regional performance was more mixed.
    - *Architectural, engineering, and related services* employed over 5,000 people in the metro region but grew at a slower pace than the industry, nationwide.
    - *Industrial process variable instruments manufacturing* was four times more concentrated in the region than nationally. However, over the past half-decade employment in the region declined during a period when the industry grew nationally.
    - *Motor and generator manufacturing* is the smallest of the six core industries, but employment in this industry is 70 percent more concentrated in Tulsa than it is nationally. Between 2014 and 2019, however, the industry lost employment at a faster rate than the industry nationally.
- *Environmental and other technical consulting services* was the weakest of the six industries. Not only did it have a relatively low concentration of employment in the region, but it also experienced significant employment declines at a time when the industry grew nationwide.

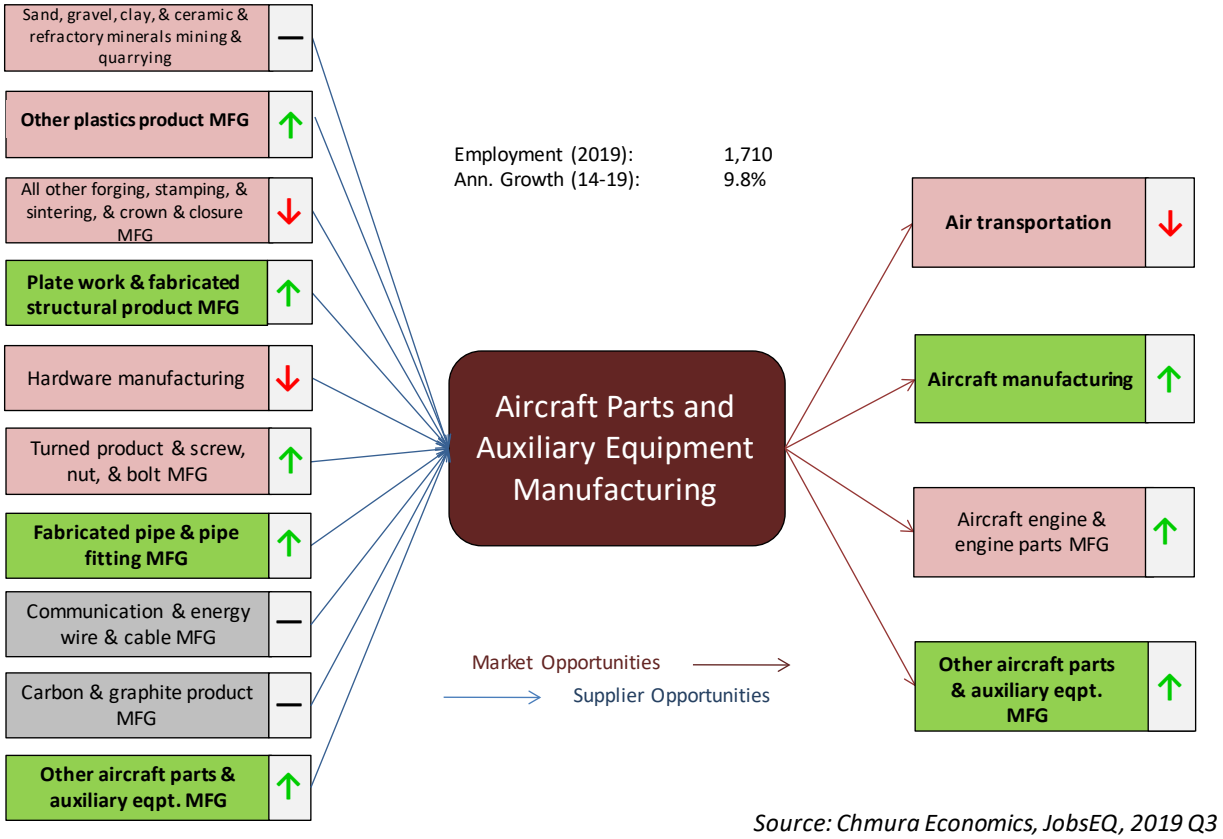
Identifying the supplier and market linkages of these industries allows us to determine potential opportunities and gaps in the autonomous vehicle industrial ecosystem. The individual value-chains for these six 'core' industries are presented below.

C1.2 AIRCRAFT PARTS

The aircraft parts and auxiliary equipment manufacturing industry represents one of the Tulsa MSA's competitive strengths. It generates significant employment (1,710 jobs), has a high relative concentration (LQ=5.46), and grew 9.8 percent annually between 2014 and 2019—a rate that far exceeded the industry national growth rate of 1.4 percent during the same period.

- The Tulsa MSA has competitive strengths in both plate work and fabricated structural product manufacturing and fabricated pipe and pipefitting manufacturing, and these industries represent additional supplier opportunities. Beyond these two industries, there is limited employment in other backward linked industries.
    -

Figure A1.2: Aircraft parts and auxiliary equipment manufacturing value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

- Despite significant losses in air transportation, buying and selling within the aircraft parts and auxiliary equipment manufacturing industry generates demand, as does demand created by aircraft manufacturers and potentially aircraft engine and engine parts manufacturers.

LABOR MARKET ASSESSMENT—AIRCRAFT PARTS & AUXILIARY EQUIPMENT MANUFACTURING

As shown in Table A1.2.1, there is generally sufficient existing labor skills available in key occupations for the industries linked to Aircraft Parts and Auxiliary Equipment Manufacturing. However, there are some occupational skills that would need to be enhanced in the local market. Many of these occupations could be filled by individuals with high school education levels and specific skill training, creating solid opportunities for workers in under-served Tulsa-area communities. A listing of key occupations requiring talent recruitment or training is shown in Table A1.2.1. Table A1.2.2 shows some key occupations that could serve as Equity Occupational Opportunities.

Table A1.2.1: Summary Assessment of Labor Market—Aircraft Parts and Auxiliary Equipment

Industry Description	Supporting Workforce? Y/N	Notes
Carbon and Graphite Product Mfg	Maybe	Needs electrical equipment Assemblers
Other Plastics Product Mfg	No	Needs people trained in molding/casting and machine setters
Forging and Stamping	Yes	Minor shortages in a few occupations
Plate Work and Fabricated Structural Product Mfg	Yes	No shortages
Hardware Mfg	Yes	No shortages
Turned Product and Screw, Nut, etc.… Mfg	No	Needs training in machinist and machine operators
Fabricated Pipe and Pipe Fitting Mfg	Yes	No shortages
Communication and Energy Wire and Cable Mfg	Maybe	Needs electrical equipment Assemblers
Sand, Gravel, Clay, and Ceramic … Mfg	No	Top 6 demanded jobs have worker shortages
Other Aircraft Parts and Aux Equip Mfg	Yes	No shortages
Air Transportation	No	Shortages in cabin & ground crew

Aircraft Mfg	Yes	No shortages
Aircraft Engine and Engine Parts Mfg	Yes	No shortages
Other Aircraft Parts and Aux Equip Mfg	Yes	No shortages

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.2.2: Equity Occupational Opportunities—Aircraft Parts and Auxiliary Equipment

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Electrical Equipment Assemblers	HS/OJT	$24.4k/$32.9k/$37.2k
Molding/Casting and Machine Setters	HS/OJT	$23.1k/$30.9k/$34.8k
Machinist and Machine Operators	HS/OJT	$31.7k/$45.9k/$53.0k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT—AIRCRAFT PARTS & AUXILIARY EQUIPMENT

Underway

Assets in Place

- Industry related to current economic development strategies
  - Aerospace Product and Parts Manufacturing
- Educational Assets
  - Central Tech
  - Green Country Tech
  - Indian Capital Tech
  - ITT Technical Institute
  - Langston University-Tulsa
  - Northeast Tech
  - Northeastern State University-Broken Arrow
  - Oklahoma State Institute of Technology-Okmulgee
  - Oklahoma State University-Tulsa
  - Oklahoma Technical College
  - Rogers State University
  - Spartan College of Aeronautics and Technology
  - Tri-County Tech
  - Tulsa Community College
  - Tulsa Tech - Broken Arrow

    - Tulsa Tech – Lemley
    - Tulsa Tech - Peoria
    - Tulsa Tech - Riverside
    - Tulsa Tech - Sand Springs
    - Tulsa Welding School
    - University of Phoenix-Tulsa
    - Vatterott College
- Targeted Entrepreneurial Support
    - Tulsa Innovation Labs
    - Oklahoma Manufacturing Alliance
    - New Product Development Center (NPDC)
    - Oklahoma Inventor's Assistance Service (IAS)
- Industry/Infrastructure Assets
    - Tulsa International Airport
    - Drones
    - AAO
- Entrepreneurial Finance
    - Acorn Growth Companies Creative Oklahoma
    - i2E (Innovation to Enterprise)
    - Oklahoma Innovation Model (OIM)
- Other

Assets needed

- EV innovation, particularly regarding components in the supply chain
- Demonstration projects to prove industry/location viability
- Place marketing combined with talent attraction for employees of targeted industries and firms.

ASSESSMENT—AIRCRAFT PARTS AND AUXILIARY EQUIPMENT

This industry cluster is well supported with existing assets, including trained workforce, with only minor weaknesses that can be addressed through focused efforts and low-to-moderate investments.

Industry firm prospects, curated—aircraft parts and auxiliary equipment

Company	City	State
CAD Enterprises, Inc.	Phoenix	AZ
Microsemi Corporation	Chandler	AZ
Northstar Aerospace	Bedford Park	IL
Systems 3, Inc.	Tempe	AZ
Advanced Thermal Sciences	Anaheim	CA
Ancra Aircraft Systems Division	Azusa	CA
Concorde Battery Corporation	West Covina	CA

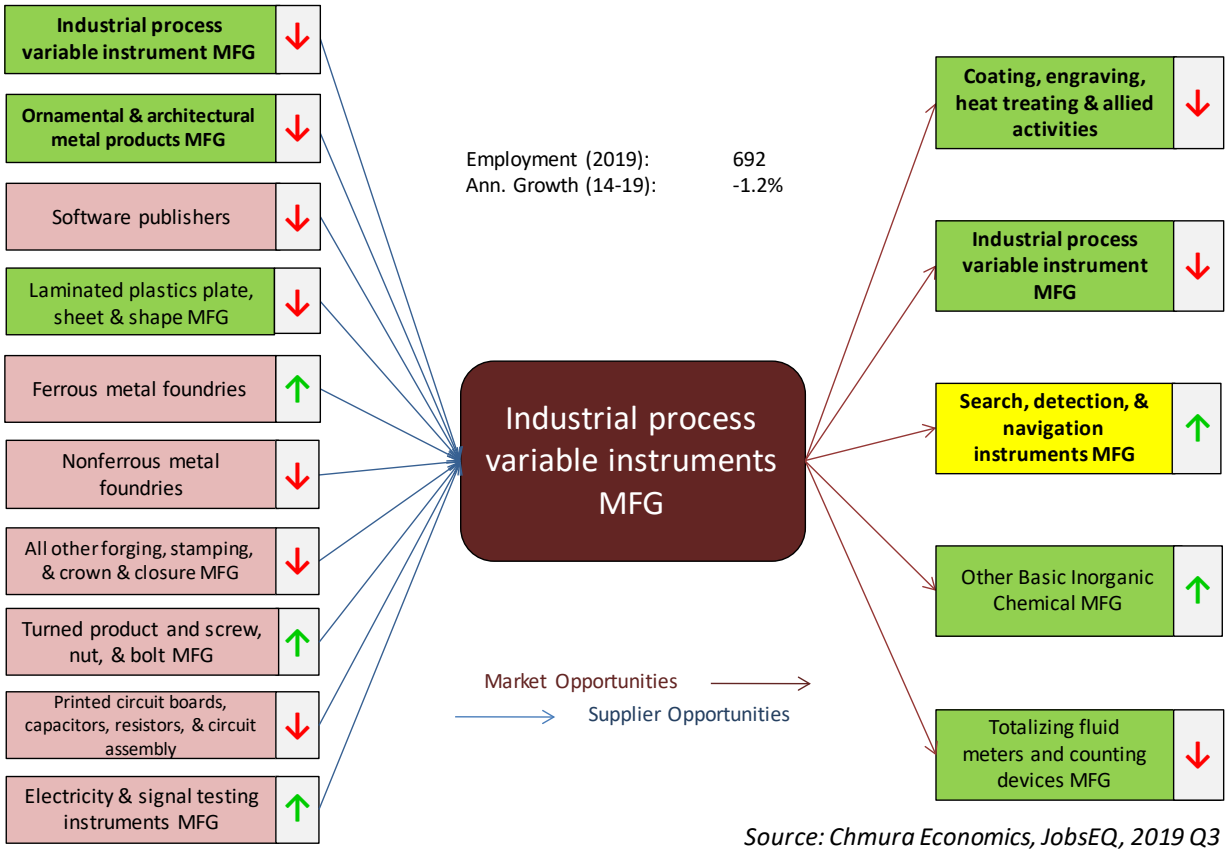
Datron World Communications, Inc.	Vista	CA
Dytran Instruments, Inc.	Chatsworth	CA
Eaton Corporation	Dublin 4	Ireland
Wetmore Tool and Engineering Company	Chino	CA
Hydroform USA	Carson	CA
Pacific Scientific Energetic Materials Company	Chandler	AZ
Rexnord Aerospace	Downers Grove	IL
United Drill bushing Corporation	Downey	CA
Beacon Industries	Wallingford	CT
PCX Aerosystems	Newington	CT
Dayton-Granger, Inc.	Fort Lauderdale	FL
Radiant Power Corporation	Sarasota	FL
Thrush Aircraft	Albany	GA
Aero-Mach Labs, Inc.	Wichita	KS
Ducommun, Inc.	Santa Ana	CA
Enstrom Helicopter Inc.	Menominee	MI
BRS Aerospace	Saint Paul	MN
US Cargo Systems	Goldsboro	NC
Engineered Systems	Hilton Head Island	SC
Safran Electronics & Defense Quality Policy	(unknown)	France
Monroe Aerospace	Melbourne	FL

Details shown at the end of this Appendix

C1.3 INDUSTRIAL INSTRUMENTS

- The industrial process variable and instruments manufacturing accounts for almost 700 jobs, and this employment is almost four times as concentrated (LQ=3.96) in the Tulsa MSA as it is nationwide. However, the industry lost employment in the region when the industry grew nationwide.
- Most of the backwardly linked industries are value-chain gaps within the region, with the exceptions of laminated plastics manufacturing and ornamental and architectural metal products manufacturing. Both industries, however, lost employment in the region between 2014 and 2019. By contrast, these industries grew nationwide during the same period.
- This industry's forward-linked industries are relatively concentrated in the region, although employment trends have not kept pace with national trends.

Figure A1.3: Industrial process variable instruments manufacturing value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

LABOR MARKET ASSESSMENT—INDUSTRIAL PROCESS & VARIABLE INSTRUMENTS

Table A1.3.1: Summary Assessment of Labor Market – Industrial Process Instruments Cluster

Industry Description	Supporting Workforce? Y/N	Notes
Instruments and Related Product Mfg	Yes	Need Engine Assemblers
Printed Circuit Assembly	No	Lacking workers in key occupations
Software Publishers	Maybe	Needs more software developers
Ferrous Metal Foundries	No	Lacking workers in key occupations
Laminated Plastics Sheet Shape Mfg	Maybe	Need machine setters for plastics
Nonferrous Metal Foundries	No	Shortages in several key occupations
Metal Crown Closure and Other	Yes	No shortages
Turned Product Nut, Screw, Mfg	Yes	Need machinist and tool operators
Ornamental and Arch Metal Work Mfg	Yes	No shortages, structural fabricators tight market
Instrument Mfg for Measuring Electricity and Signals	Yes	Need Engine Assemblers
Coating, Engraving, Heat Transfer. Activities	No	Shortages in top demanded jobs
Instruments and Related Product Mfg	Yes	Need Engine Assemblers
Search, Detection, Navi… Mfg	Yes	Need Engine Assemblers,
Other Basic Inorganic Chem Mfg	No	Need chemical plant workers, operators, engineers, tenders, etc.
Totalizing Fluid Meter… Mfg	Yes	Need Engine Assemblers

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.3.2: Equity Occupational Opportunities—Industrial Process Instruments Cluster

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Engine Assemblers	HS/OJT	$29.2k/$41.9k/$48.2k
Machinists and Tool Operators	HS/OJT	$31.7k/$45.9k/$53.0k
Machine Setters	HS/OJT	$23.1k/$30.9k/$34.8k
Structural Fabricators	HS/OJT	$27.8k/$36.9k/$41.4k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT—INDUSTRIAL PROCESS & VARIABLE INSTRUMENTS

Assets in Place

- Industry related to current economic development strategies
    - Advanced Manufacturing
    - Energy
- Educational Assets
    - Central Tech
    - Green County Tech
    - Indian Capital Tech
    - ITT Technical Institute
    - Langston University-Tulsa
    - Northeast Tech
    - Oklahoma State Institute of Technology – Okmulgee
    - Oklahoma State University-Tulsa
    - Oklahoma Technical College
    - Rogers State University
    - Tri-County Tech
    - Tulsa Community College
    - Tulsa Tech – Broken Arrow
    - Vatterott College
- Targeted Entrepreneurial Support
    - Oklahoma Manufacturing Alliance
    - New Product Development Center (NPDC)
    - Oklahoma Inventor's Assistance Service (IAS)
    - Oklahoma Center for the Advancement of Science and Technology (OCAST)
    - Tulsa Innovation Labs
- Industry/Infrastructure Assets
    - TIA
    - Drones
    - AAO
- Entrepreneurial Finance
    - Cimarron Capital Partners
    - Pennington Allen Capital Partners
    - i2E (Innovation to Enterprise)
    - Oklahoma Innovation Model (OIM)
- Other

Assets Needed

- Demonstrable programs in place to provide rapid training of workers representing skill shortages within a company site location time schedule
- Notable gaps in local supply chain components (vendors). Need resource list of a) potential regional sources of supplies, or b) recruitment strategy to build a support cluster of firms.

- Internal communication strategy supporting this important but atypical industry for recruitment.

ASSESSMENT—INDUSTRIAL PROCESS & VARIABLE INSTRUMENTS

This industry cluster is supported with existing assets and thus is a viable target opportunity. However, there are notable gaps in workforce skills and supporting supply chain vendors that should be addressed, as appropriate. In addition, the marketing for attracting investments in this sector need to include addressing the weaknesses identified above. These can be addressed through focused efforts and low-to-moderate investments.

Industry Firm Prospects, Curated —Industrial Process & Variable Instruments

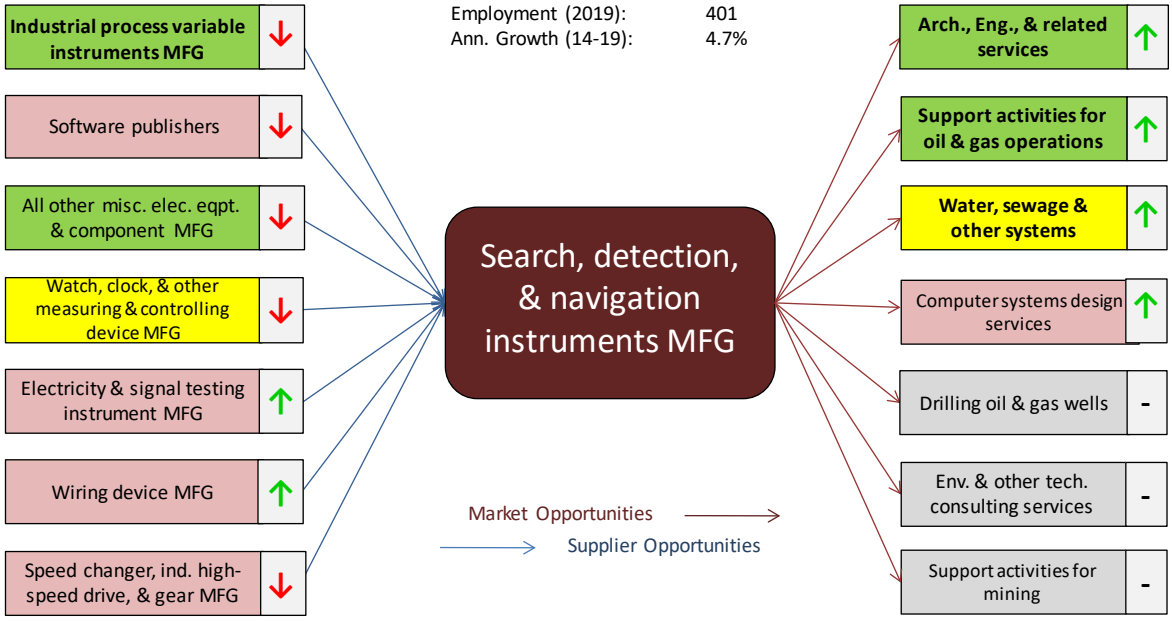
Company	City	State
Leonardo DRS	Arlington	VA
MSA, The Safety Company	Cranberry Township	PA
Georg Fischer LLC	Irvine	CA
Maury Microwave Corporation	Ontario	CA
OMRON Robotics and Safety Technologies	Pleasanton	CA
OPTO 22	Temecula	CA
Gems Sensor & Controls	Plainville	CT
DICKEY-john	Auburn	IL
Endress+Hauser USA	Greenwood	IN
Sevcon	Southborough	MA
Progressive Dynamics, Inc.	Marshall	MI
Banner Engineering Corporation	Minneapolis	MN

Details shown at the end of this Appendix

C1.4 PRECISION INSTRUMENTS

- Search, detection, and navigation instruments manufacturing is an emerging industry within the Tulsa metro area. Between 2014 and 2019, the industry added 80 net new jobs within the region and grew more than three times faster than the US rate.
- Among backwardly-linked industries, the industrial process variable instruments manufacturing industry was the largest and most concentrated. However, most supplier opportunities are in industries without a significant regional presence.
- The strongest market opportunity for search, detection and navigation instruments manufacturers comes from the aircraft parts and auxiliary equipment manufacturing industry.

Figure A1.4: Search, detection and navigation instruments manufacturing value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

LABOR MARKET ASSESSMENT – SEARCH & NAVIGATION EQUIPMENT CLUSTER

As shown in Table A1.4.1, there is generally sufficient existing labor skills available in key occupations for the industries linked to Aircraft Parts and Auxiliary Equipment Manufacturing. However, there are some occupational skills that would need to be enhanced in the local market. Many of these occupations could be filled by individuals with high school education levels and specific skill training, creating solid opportunities for workers in under-served Tulsa-area communities. A listing of key occupations requiring talent recruitment or training in shown in Table A1.4.1. Table A1.4.2 shows some key occupations that could serve as Equity Occupational Opportunities.

Table A1.4.1: Summary Assessment of Labor Market – Search & Navigation Equipment Cluster

Industry Description	Supporting Workforce? Y/N	Notes
Speed Changer, Industrial…Gear Mfg	Yes	Needs Engine Assemblers
Instruments for Measuring Elect/Signals	Yes	Needs Engine Assemblers
Software Publishers	Maybe	Needs more software developers
Oth. Measuring/Controlling Device Mfg	Yes	Needs Engine Assemblers
Instruments and Related Product Mfg	Yes	Needs Engine Assemblers
Wiring Device Mfg	Maybe	Needs Engine Assemblers
Other Electrical Equip & Component Mfg	Maybe	Needs Engine Assemblers
Architectural, Eng., Related Services	No	Lacking civil engineers, architects, crafters, etc. - highly educated workers
Support Activities for Oil and Gas Ops	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.
Computer Systems Design Services	Yes	Still needs more software developers, but this industry is possible

Drilling Oil and Gas Wells	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.
Environmental Consulting Services	Yes	Need Management Analysts
Support Activities for Mining	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.4.2: Equity Occupational Opportunities—Search & Navigation Cluster

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Engine Assemblers	HS/OJT	$29.2k/$41.9k/$48.2k
Surveying & Mapping Technicians	HS/OJT/Some College	$29.7k/$56.2k/$69.4k
Civil Engineering Technicians	Assoc. Degree	$33.3k/$48.7k/$56.4k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT –SEARCH & NAVIGATION EQUIPMENT CLUSTER

Assets in Place

- Industry related to current economic development strategies
    - Advanced Manufacturing
    - Aerospace
    - Transportation and Logistics
- Educational Assets
    - U-Tulsa [programs, research centers]
    - Central Tech
    - Green Country Tech
    - Indian Capital Tech
    - ITT Technical Institute
    - National American Institute
    - Northeast Tech
    - Oklahoma Baptist University
    - Oklahoma State Institute of Technology – Okmulgee
    - Oklahoma State University – Tulsa
    - Oklahoma Technical College
    - Roadmaster Trucking
    - Tri-County Tech
    - Tulsa Community College
    - Tulsa Tech – Broken Arrow
    - Vatterott College
- Targeted Entrepreneurial Support
    - Oklahoma Manufacturing Alliance
    - New Product Development Center (NPDC)
    - Oklahoma Inventor's Assistance Service (IAS)
    - Oklahoma Center for the Advancement of Science and Technology (OCAST)
    - OneOCII
- Industry/Infrastructure Assets
    - Tulsa International Airport
    - Drones
    - Port of Catoosa
    - AAO
- Entrepreneurial Finance
    - Acorn Growth Companies Creative Oklahoma
    - Oklahoma Seed Capital Fund
    - Spur Capital Partners
    - i2E (Innovation to Enterprise)
    - Oklahoma Innovation Model (OIM)
- Other

Assets Needed

- Work with post-secondary education resources to address potential talent shortages in software development.
- Positive trends in employment in some supply chain vendor sectors indicates relatively minor weakness that can likely be addressed through the expansion of existing firms.
- The key firms directly supporting the development and provision of equipment supporting autonomous vehicles may require notable efforts supporting the Tulsa region's ability to attract and retain talented workers in key occupations. This may be especially true for firms providing cutting edge technologies.
- Existing higher education centers and programs could be especially helpful with this group by providing a pool of talented workers who are already based in the region. Consider a strategic partnership with academic programs, existing university research centers, and local economic development groups.

ASSESSMENT – SEARCH & NAVIGATION EQUIPMENT CLUSTER

This industry cluster is reasonably well supported with existing assets and only minor weaknesses that can be addressed through focused efforts. Establishing a critical mass of skilled workers and technology that is able to be commercialized implies the need for focused university/business/government engagement.

Industry Firm Prospects, Curated – Search & Navigation Equipment Cluster

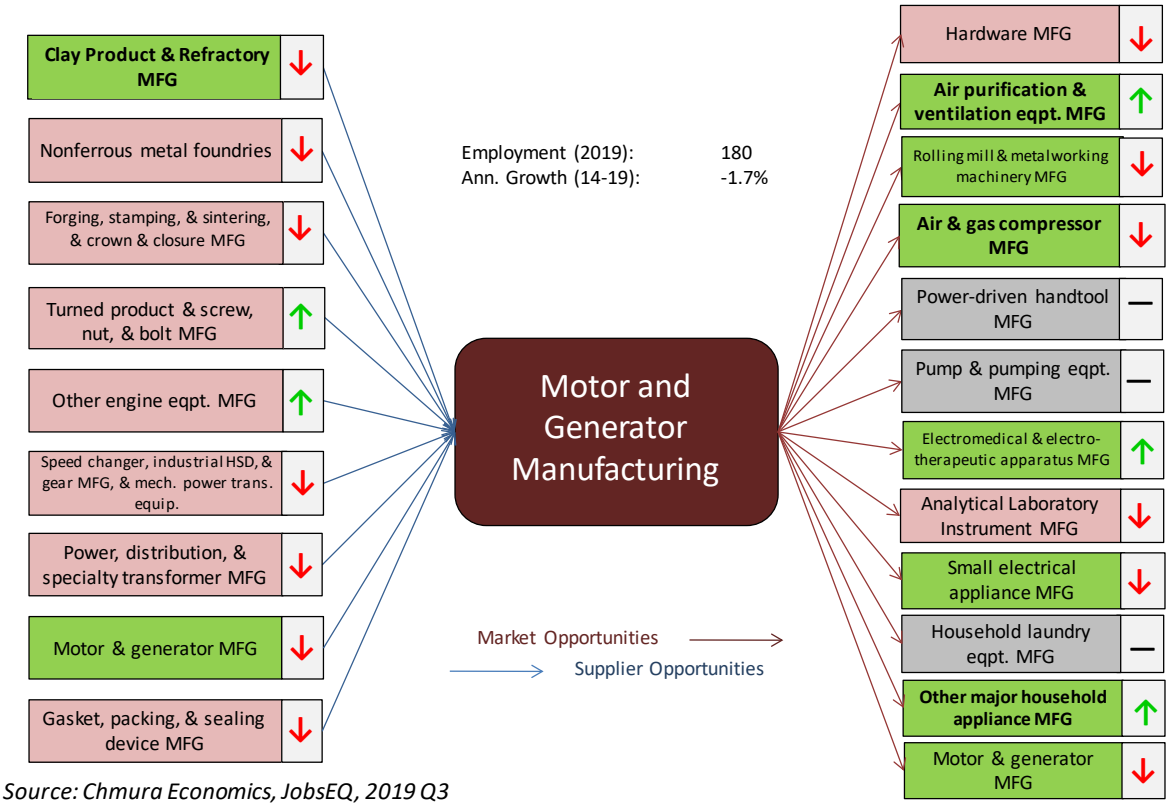
Company	City	State
AgJunction, Inc.	Scottsdale	AZ
Universal Avionics	Tucson	AZ
Del Mar Avionics	Irvine	CA
JAVAD	San Jose	CA
Computrol	Meridian	ID
Trimble MAPS	Princeton	NJ
OHAUS Corporation	Parsippany	NJ
Orbit International Corporation	Hauppauge	NY

Details shown at the end of this Appendix

C1.5 MOTORS AND GENERATORS

- The motor and generator manufacturing industry is relatively small (180 jobs) and concentrated in the region (LQ=1.72), but the industry lost jobs both in the region and nationally between 2014 and 2019.
- The supplier industries that feed into motor and generator manufacturing are largely small and undeveloped within the region.
- There are several very strong market opportunities including air purification and ventilation equipment manufacturing, and other major household appliance manufacturing. As a result, motor and generator manufacturers are less directly connected to vehicle manufacturing.

Figure A1.5: Motor and generator manufacturing value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

LABOR MARKET ASSESSMENT – MOTOR & GENERATOR CLUSTER

As shown in Table A1.5.1, there is generally sufficient existing labor skills available in key occupations for the industries linked to Aircraft Parts and Auxiliary Equipment Manufacturing. However, there are some occupational skills that would need to be enhanced in the local market. Many of these occupations could be filled by individuals with high school education levels and specific skill training, creating solid opportunities for workers in under-served Tulsa-area communities. A listing of key occupations requiring talent recruitment or training in shown in Table A1.5.2. Table A1.5.2 shows some key occupations that could serve as Equity Occupational Opportunities.

Table A1.5.1: Summary Assessment of Labor Market – Motor & Generator Cluster

Industry Description	Supporting Workforce? Y/N	Notes
Clay Product and Refactory	Yes	Will be short on "molders, shapers, etc." but this type of work is easily trainable
Motor Generator Mfg	Maybe	Need Electrical Equip Assemblers
Forging and Stamping	Yes	Minor shortages
Turned Product Nut, Screw, Mfg	Yes	Need machinist and tool operators
Power, Distribution, Specialty Mfg	Maybe	Need Electrical Equip Assemblers
Other Engine Equip Mfg	Yes	Need Engine Assemblers
Speed Changer, Industrial…Gear Mfg	Yes	Need Engine Assemblers
Air and Gas Comp Mfg	Yes	no shortages of workers
Electro medical Mfg	Maybe	Need some Electrical Equip Assemblers
Hardware Mfg	Yes	Small shortage Grinding, Lapping, Buffing Machine Setter
Major Household Appliance Mfg	Yes	Need Team Assemblers
Motor Generator Mfg	Maybe	Need Electrical Equip Assemblers
Power-Driven Hand tool Mfg	Yes	No shortages of workers
Pump and Compressor Mfg	Yes	No Shortages of workers
Rolling Mill and Other Mfg	No	Large shortage in key occupations
Small Electrical Appliance Mfg	Yes	Need team assemblers

Ventilation, Heating, Etc. Mfg	Yes	No shortages of workers

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.5.2: Equity Occupational Opportunities—Motor & Generator Cluster

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Molders, Shapers, Casters not metal/plastic	HS/OJT	$23.1k/$30.9k/$34.8k
Furnace/Kiln Operators	HS/OJT	$27.0k/$39.5k/$45.7k
Extruding/Forming/Pressing Machine Oper.	HS/OJT	$31.3k/$42.4k/$48.0k
Mixing, Blending Machine Setters	HS/OJT	$29.0k/$46.6k/$55.4k
Cutting/Slicing Machine Setters	<HS/HS	$20.7k/$29.6k/$34.0k
Team Assemblers	HS/OJT	$22.5k/$32.2k/$37.1k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT—MOTOR & GENERATOR CLUSTER

Assets in Place

- Industry related to current economic development strategies
  - Advanced Manufacturing
  - Aerospace
  - Transportation and Logistics
  - Energy
- Educational Assets
  - U-Tulsa [programs, research centers]
  - 4m Welding
  - Central Tech
  - Green Country Tech
  - Indian Capital Tech
  - ITT Technical Institute
  - Langston University—Tulsa
  - Northeast Tech
  - Northeastern State University-Broken Arrow
  - Oklahoma Baptist University
  - Oklahoma State Institute of Technology
  - Oklahoma State Institute of Technology - Okmulgee
  - Oklahoma State University-Tulsa
  - Oklahoma Technical College

    - Rogers State University
    - Southern Nazarene University
    - Spartan College of Aeronautics and Technology
    - Tri-County Tech
    - Tulsa Community College
    - Tulsa Tech - Broken Arrow
    - Tulsa Tech – Lemley
    - Tulsa Tech - Peoria
    - Tulsa Tech - Riverside
    - Tulsa Tech - Sand Springs
    - Tulsa Welding School
    - University of Phoenix-Tulsa
    - University of Tulsa
    - Vatterott College
- Targeted Entrepreneurial Support
    - Oklahoma Manufacturing Alliance
    - New Product Development Center (NPDC)
    - Oklahoma Inventor's Assistance Service (IAS)
    - University of Oklahoma Energy Institute
- Industry/Infrastructure Assets
    - TIA
    - Drones
    - AAO
- Entrepreneurial Finance
    - i2E (Innovation to Enterprise)
    - Oklahoma Innovation Model (OIM)
    - Pennington Allen Capital Partners

Assets Needed

- A key element in diversifying a local/regional economy is developing an effective communications strategy that signals to prospective companies, site location consultants and others that existing resources, including a skilled workforce and supporting innovation eco-system are present in sufficient measure for the "new" industry to be successful. This likely requires a modified and expanded economic development marketing effort, which should also be tied to talent attraction initiatives. This asset is required for all identified industry clusters and will be identified as Economic Development Marketing Strategy in subsequent sections of this report for brevity.
- Several of the supply chain vendor industries show notable weakness in the Tulsa region. However, the demand for products made by these sectors can potentially be provided by existing regional firms with only minor changes in their product mix, and could be the basis for entrepreneurial opportunities, especially by appropriately skilled workers already present in Tulsa. This requires coordinated efforts with SBDC programs and appropriate business accelerator programs.

- Demonstration projects focused on electric vehicles for passenger transit and freight/material handling would help build market perception of Tulsa as a viable site for this industry.
- Existing manufacturers of automotive electric vehicle engines and components are embedded in other localities and regions pointing to the need for business recruitment and development strategies to target non-automotive electric vehicles including air, marine, robotics, farm equipment and other market segments.

ASSESSMENT – MOTOR & GENERATOR CLUSTER

This industry cluster is well supported with existing workforce assets with only minor weaknesses that can be addressed through focused trainings efforts. The relative weakness of the supply chain vendor network may create market challenges in making it on the short list of firms willing to consider Tulsa as a site location. Therefore, the marketing message used to attract firms in this sector should include the relative availability of the products and services affected by supply chain gaps.

Industry Firm Prospects—Motor & Generator Cluster

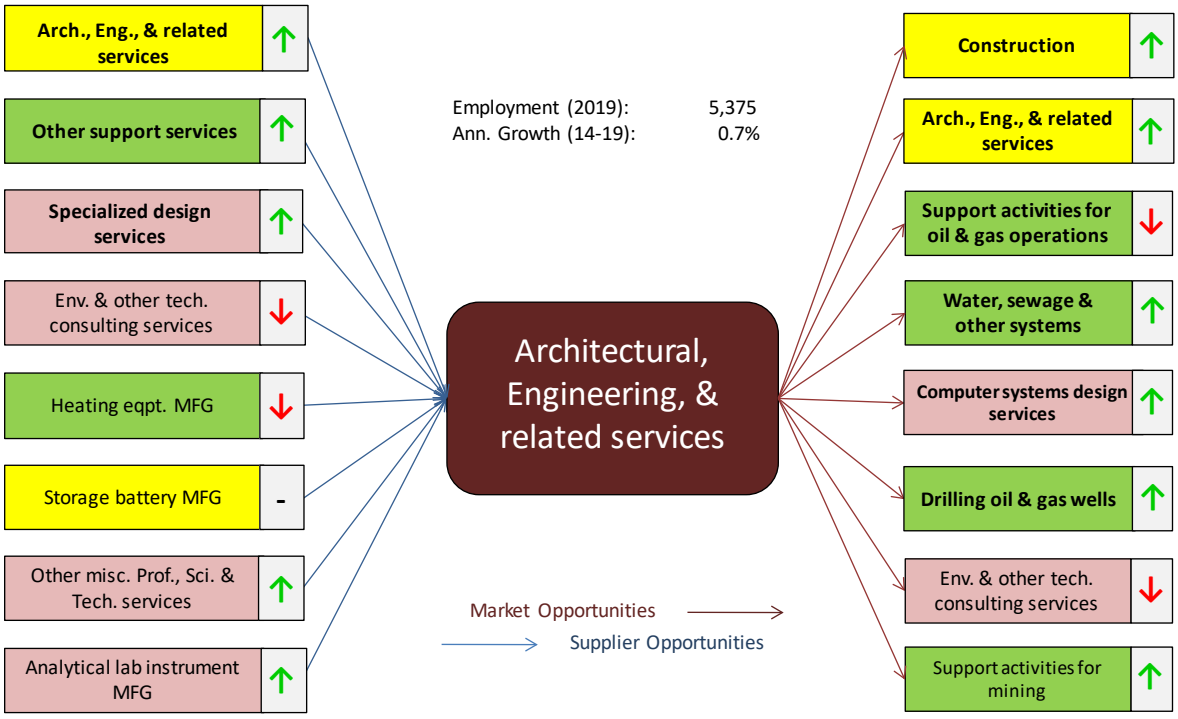
Company	City	State
Connector Manufacturing Co	Hamilton	OH
Globe Motors	Amherst	NY
Southwire Co	Carrollton	GA
ABB Inc	Cary	NC
Cummins Rocky Mountain LLC	Columbus	IN
Keller Electrical Industries	Phoenix	AZ
Southwest Products Corp	Surprise	AZ
Alturdyne Power Systems LLC	El Cajon	CA
Anritsu Co	Atsugi	Japan
Eaton Cooper Interconnect	Irvine	CA
Electric Motor Shop	Fresno	CA
Hawthorne Power System	San Diego	CA
L3harris Power Paragon Inc	Melbourne	FL
Mechanical Analysis Repair Inc	Lodi	CA
Peterson Power Systems	San Leandro	CA
Polar Power Inc	Gardena	CA

Details shown at the end of this Appendix.

C1.6 ARCHITECTURE & ENGINEERING

- The Tulsa region's architectural, engineering, and related services industry employs over 5,300 workers, making it almost 20 percent more concentrated in the US than it is nationally. This industry experienced growth over the past five years (0.7 percent annually), but at a rate slower than the US industry (1.8 percent annually).
- The region's backward linkages are relatively weak, except for intra-industry purchases, as well as from the other support services industry.[6]
- Within the Tulsa metro areas, the market opportunities for this industry are driven in part by construction, as well as the region's existing strengths in oil and gas.

Figure A1.6: Architectural, engineering, and related services value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

[6] Other support services (NAICS 5619) include a variety of activities such as packaging services, flagging (i.e., traffic control) services, inventory taking services, contract meter reading services, lumber grading services, or commercial diving services.

LABOR MARKET ASSESSMENT—ARCHITECTS & ENGINEERING

As shown in Table A1.6.1, there is generally sufficient existing labor skills available in key occupations for the industries linked to Aircraft Parts and Auxiliary Equipment Manufacturing. However, there are some occupational skills that would need to be enhanced in the local market. Many of these occupations could be filled by individuals with high school education levels and specific skill training, creating solid opportunities for workers in under-served Tulsa-area communities. A listing of key occupations requiring talent recruitment or training in is also shown in TableA1.6.1. Table A1.6.2 shows some key occupations that could serve as Equity Occupational Opportunities.

Table A1.6.1: Summary Assessment of Labor Market – Architect & Engineering

Industry Description	Supporting Workforce? Y/N	Notes
Architectural, Eng., Related Services	No	Lacking civil engineers, architects, crafters, etc. - highly educated workers
Specialized Design Services	No	Needs creative professionals: graphic design, interior design, industrial design, etc.
Environmental Consulting Services	Yes	Needs more Management Analysts
Heating Equipment	Yes	No Shortages
Storage Battery Manufacturing	Maybe	Would need Electronic Assemblers
Other Professional, Sci, Tech Services	No	Many shortages
Analytical Lab Instrument Mfg	Yes	Small shortage Electronic Assemblers
Support Activities for Mining	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.
Computer Systems Design Services	Yes	Need software developers
Drilling Oil and Gas Wells	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.
Construction	Yes	No shortages
Support Activities for Oil and Gas Ops	No	Tight supply for roustabouts, service unit operators, drill & derrick ops.

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.6.2: Equity Occupational Opportunities—Architect & Engineering

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Electronic Assemblers	HS/OJT	$24.4k/$32.9k/$37.2k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT—ARCHITECT & ENGINEERING

Assets in Place

- Industry related to current economic development strategies
    - Professional Services
    - Transportation and Logistics
- Educational Assets
    - University of Tulsa [programs, research centers]
    - Central Tech
    - Green Country Tech
    - Indian Capital Tech
    - Langston University—Tulsa
    - Northeast Tech
    - Tri-County Tech
    - Tulsa Community College
    - Tulsa Tech – Broken Arrow
    - University of Phoenix-Tulsa
- Targeted Entrepreneurial Support
    - Oklahoma Center for the Advancement of Science and Technology (OCAST)
- Industry/Infrastructure Assets
    - Tulsa International Airport
    - Drones
    - AAO
- Entrepreneurial Finance
    - Pennington Allen Capital Partners
    - Bison Fund Management

Assets Needed

- Improved supply of engineers and designers, either through local talent pipelines or talent attraction programs.
- Some of the noted talent shortages may no longer be appropriate given disruptions in oil and gas production during the pandemic. There may be some opportunities for the re-training of existing workers in skill shortages.
- Examination of detailed skills and capabilities of existing Tulsa firms in this sector could indicate business expansion opportunities, but a more detailed assessment is needed.

ASSESSMENT—ARCHITECTS & ENGINEERING

This industry cluster is reasonably well supported by existing assets, with the notable exception of potential shortages in engineers and graphic design specialists. Marketing strategies need to highlight post-secondary educational assets with the potential of adding or adapting existing academic programming to meet the potential demand attending the attraction of firms in these sectors.

Industry Firms—Architects & Engineering [focus on survey and mapping]

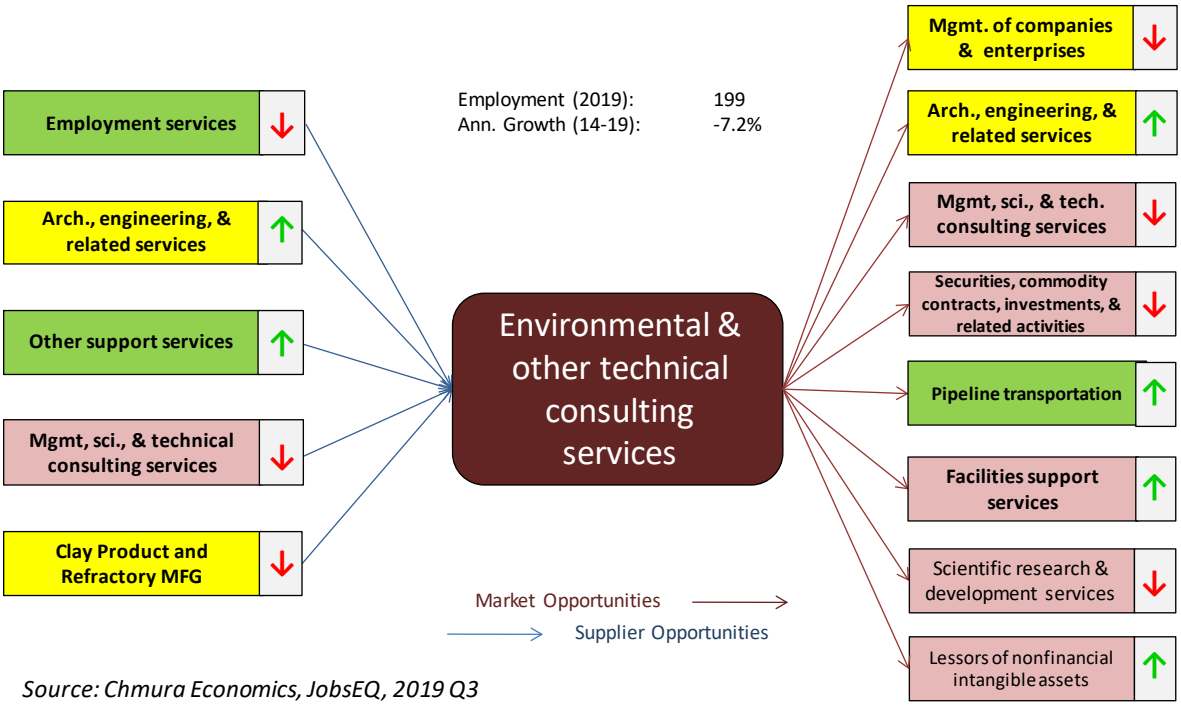
Company	City	State
Whpacific Inc	Albuquerque	NM
Garver LLC	Tempe	AZ
David Evans & Assoc Inc	Portland	OR
Protex The Pt Xperts LLC	Tempe	AZ
Albert A WEBB Assoc	Riverside	CA
BKF Engineers	Redwood City	CA
Cannon Associates	Bakersfield	CA
GDR Group Inc	Irvine	CA
Intellisurvey Inc	Mission Viejo	CA
Provost & Pritchard Consulting	Fresno	CA
Psomas	Auburn	CA
Rick Engineering Co	San Diego	CA
RRM Design Group	San Luis Obispo	CA
Westland Group Inc	Ontario	CA
Yolano Engineers Inc	Napa	CA
Flatirons Inc	Boulder	CO
Edminster Hinshaw Russ & Assoc	Houston	TX
Loureiro Engineering Assoc Inc	Plainville	CT

Details shown at the end of this Appendix

C1.7 TECHNICAL CONSULTING

- The Tulsa region's environmental and other technical consulting services industry is relatively small (200 jobs), not highly concentrated (LQ=0.73), and lost employment (-7.3 percent annually) at a time when the industry grew nationally (1.1 percent) between 2014 and 2019.
- The backward linked industries have overlapping strengths with architectural, engineering, and related services, but other backward linked industries lost employment in the region between 2014 and 2019.
- Although not the largest market opportunity, pipeline transportation is one of the strongest market opportunities for the region's environmental and other technical consulting services industry. The pipeline transportation industry employs approximately 1,350 workers in the region and is 9.5 times more concentrated in the Tulsa MSA than it is nationwide. As a result, the oil and gas industry have the potential to support growth in environmental and other technical consulting services.

Figure A1.7: Environmental and other technical consulting services value-chain



Source: Chmura Economics, JobsEQ, 2019 Q3

LABOR MARKET ASSESSMENT—ENVIRONMENTAL & TECHNICAL CONSULTING

As shown in Table A1.7.1, there is generally sufficient existing labor skills available in key occupations for the industries linked to Aircraft Parts and Auxiliary Equipment Manufacturing. However, there are some occupational skills that would need to be enhanced in the local market. Many of these occupations could be filled by individuals with high school education levels and specific skill training, creating solid opportunities for workers in under-served Tulsa-area communities. A listing of key occupations requiring talent recruitment or training in shown in Table A1.7.2. Table A1.7.2 shows some key occupations that could serve as Equity Occupational Opportunities.

Table A1.7.1: Summary Assessment of Labor Market—Environmental & Technical Consulting

Industry Description	Supporting Workforce? Y/N	Notes
Architectural, Eng., Related Services	No	Lacking civil engineers, architects, crafters, etc. - highly educated workers
Employment Services	Yes	No shortages
Mgmt, Sci, Tech Consulting Services	No	Shortage in largest demand - highly educated high skilled workers-management analysts
Clay Product and Refactory	Yes	Need molders, shapers, etc.
Management of Enterprises	Yes	No shortage
Architectural, Eng., Related Services	No	Lacking civil engineers, architects, crafters, etc. - highly educated workers
Mgmt, Sci, Tech Consulting Services	No	Shortage in largest demand - highly educated high skilled workers-management analysts
Securities, Commodities, and Other Financial…	No	Lacks top demanded jobs
Pipeline Transportation	No	Lacks top 2 demanded jobs, which require education
Facilities Support Services	Maybe	Most likely okay but needs more correctional officers
Scientific R&D Services	No	Lacks top jobs which require higher level education

Lessors of Nonfinancial Intangible Assets	Yes	No Shortage

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

Table A1.7.2: Equity Occupational Opportunities—Environmental & Technical Consulting

Description	Education/Skills Requirements	Wage Starting/Avg/Experienced
Civil Engineering Technicians	Assoc.Degree	$33.3k/$48.7k/$56.4k
Surveying & Mapping Technicians	HS/OJT/Some College	$29.7k/$56.2k/$69.4k
Molders, Shapers, Casters ex. Metal/Plastic	HS/OJT	$23.1k/$30.9k/$34.8k
Furnace Kiln Operators	HS/OJT	$27.0k/$39.5k/$45.7k
Extruding Machine Operators	HS/OJT	$31.3k/$42.4k/$48.0k

Sources: Chmura Economics, Bureau of Labor Statistics, Clower & Assoc.

INNOVATION ECO-SYSTEM ASSESSMENT—ENVIRONMENTAL & TECHNICAL CONSULTING

Assets in Place

- Industry related to current economic development strategies
  - Professional Services
  - Energy
- Educational Assets
  - Central Tech
  - Community Care College
  - Green Country Tech
  - Indian Capital Tech
  - Langston University—Tulsa
  - Northeast Tech
  - Oklahoma Baptist University
  - Oklahoma State Institute of Technology
  - Oklahoma State Institute of Technology - Okmulgee
  - Oklahoma State University-Tulsa
  - Rogers State University
  - Tri-County Tech
  - Tulsa Community College
  - Tulsa Tech - Broken Arrow
  - Tulsa Tech – Lemley
  - Tulsa Welding School
  - University of Tulsa [programs, research centers]
  - University of Phoenix-Tulsa
  - University of Tulsa
  - Vatterott College

- Targeted Entrepreneurial Support
    - Oklahoma Center for the Advancement of Science and Technology (OCAST)
- Industry/Infrastructure Assets
    - Tulsa International Airport
    - Drones
    - AAO
- Entrepreneurial Finance
    - Pennington Allen Capital Partners
    - Bison Fund Management
- Other

Assets Needed

- Post-secondary education resources targeted to gaps in the availability of skills noted above, combined with a talent retention initiative targeting graduates or area university programs in these fields.
- Recruitment efforts, due in part to the breadth of skills represented by this sector, need to be engaged with a highly focused marketing plan that looks for key connections among sector firms and business activities directly related to mobility innovation.
- Demonstration projects showing regional capabilities to support emerging businesses focused on mobility innovation will attract the attention of target-potential firms.

ASSESSMENT—ENVIRONMENTAL & TECHNICAL CONSULTING

This industry cluster is well supported through its usual vendor networks. However, there are numerous gaps in labor skills for this and related sectors. These gaps are too numerous to address through speculative industry training programming. Therefore, this sector is best considered as a secondary opportunity—active engagement in firm recruitment happens when the assets related to autonomous and electric vehicles are developed through other related activities. Be ready to actively engage firms with a targeted marketing campaign, but not as a first-wave industry.

Industry Firms—Environmental & Technical Consulting

Company	City	State
Contact Network	Little Rock	AR
Deshazo Automation (Decatur, AL)	Bessemer	AL
Benchmark Group	Rogers	AR
Agjunction Inc	Scottsdale	AZ
M3 Engineering & Technology	Tucson	AZ
Mintec Inc	Tucson	AZ
Securaplane Technologies Inc	Tucson	AZ

Details shown at the end of this Appendix

C1.8 LINKED INDUSTRIES

The six core industries each have distinct buyer and supplier relationships, but their commonly linked industries are foundational to the region's autonomous vehicle industrial ecosystem. Figure A1.8 identifies the linked industries that appear in the value-chains of multiple 'core' industries. The region's existing strengths in aircraft and aircraft parts manufacturing represent a significant driver of demand within several of the more manufacturing-oriented core industries—such as aircraft parts and auxiliary equipment manufacturing and search, detection, and navigation instruments manufacturing. Many of the other linked industries that appear in multiple value-chains have a less significant regional presence. This includes both manufacturing industries (e.g., electricity and signal testing instruments MFG, hardware MFG) and services (e.g., software publishers). Growth in the core industries could potentially lead to growth in these linked industries.

In addition to the aviation industry the region's oil and gas industry represents another key source of demand, particularly for the service-oriented core industries. Oil and gas industries such as oil and gas well drilling, support activities for mining, and support activities for oil and gas operations have a relatively strong presence in the Tulsa region and represent market opportunities for firms in architectural, engineering and related services. Similarly, the pipeline transportation industry is relatively concentrated and is one of the region's stronger market opportunities for environmental and other technical consulting services.

The value-chain analysis shows that regional strengths—in both aviation-related manufacturing and oil and gas—can drive demand in industries that also support autonomous vehicles. Since innovation often occurs at the intersection of technologies or market areas, the Tulsa region might consider exploring how unmanned aerial systems (e.g., drones) can support the region's oil and gas industries. As a result, the region's efforts to develop autonomous vehicles should extend beyond transportation and transit to include strategies for leveraging these technologies for more remote sensing applications.

Figure A1.8: Industries linked to multiple core industries

NAICS	Industry	Jobs (2019)	Annual Job Growth (14-19)	LQ (2019)	Linked to Core Industries (B=Backward, F=Forward)
Regional strengths or emerging opportunities					
336411	Aircraft MFG	6,791	14.8%	10.39	Aircraft parts & auxiliary eqpt. MFG (F); Search, detection, & navigation instruments MFG (F)
336413	Aircraft parts & auxiliary eqpt. MFG	1,710	9.8%	5.46	Aircraft parts & auxiliary eqpt. MFG (B, F); Search, detection, & navigation instruments MFG (F)
334513	Industrial process variable instruments MFG	692	-1.2%	3.96	Industrial process variable instruments MFG (B); Search, detection, & navigation instruments MFG (F)
5619	Other support services	2,476	9.7%	2.42	Arch., engineering, & related services (B); Environ. & other tech. consulting services (B)
5413	Arch., engineering, & related services	5,375	0.7%	1.20	Arch., engineering, & related services (B, F); Environ. & other tech. consulting services (B, F)
334511	Search, detection, & navigation instruments MFG	401	4.7%	1.11	Industrial process variable instruments MFG (B); Search, detection, & navigation instruments MFG (F)
Gaps in the industrial ecosystem					
54162	Environ. & other tech. consulting services	199	-7.2%	0.73	Arch., engineering, & related services (B, F)
33152	Nonferrous metal foundries	109	-4.0%	0.70	Industrial process variable instruments MFG (B); Motor & Generator MFG (B)
54161	Management, scientific, and technical consulting services	1,672	-3.0%	0.43	Environ. & other tech. consulting services (B, F)
334515	Electricity and signal testing instruments MFG	41	7.9%	0.39	Industrial process variable instruments MFG (B); Search, detection, & navigation instruments MFG (B, F)
33211	All other forging, stamping, & sintering, & crown & closure MFG	95	-1.0%	0.34	Industrial process variable instruments MFG (B); Motor & Generator MFG (B); Aircraft parts & auxiliary eqpt. MFG (B);
33272	Turned product & screw, nut, & bolt MFG	55	1.5%	0.24	Industrial process variable instruments MFG (B); Motor & Generator MFG (B); Aircraft parts & auxiliary eqpt. MFG (B)
5112	Software publishers	212	-0.1%	0.17	Industrial process variable instruments MFG (B); Search, detection, & navigation instruments MFG (B)
334516	Analytical Laboratory Instrument MFG	14	18.5%	0.13	Arch., engineering, & related services (B); Motor & Generator MFG (F)
3325	Hardware MFG	6	-22.2%	0.08	Motor & Generator MFG (F); Aircraft parts & auxiliary eqpt. MFG (B)
333612, 333613	Speed changer, industrial high-speed drive, & gear MFG, & mechanical power transmission eqpt.	3	-15.6%	0.04	Motor & Generator MFG (B); Search, detection, & navigation instruments MFG (B)

Source: Chmura Economics, JobsEQ

**Core industries included if linkages extend beyond intra-industry purchases.*

C1.9 OPPORTUNITIES

In addition to the linked industries described in the preceding section, there are notable industry/firm opportunities for recruitment and development efforts. These industry sectors do not fit cleanly within any given NAICS code and thus are not easily discernable in data-driven analyses of economic development opportunities. Even where the sector or firm may clearly fall into one of the sectors we have previously identified in this report, it is worthy of calling them out for special attention for two reasons:

- These sectors/firms represent the cutting edge of technology applications that shape New Mobility and the adoption of new transportation related technologies by a wide range of industries; and
- The presence of firms represented by this group is a clear signal to businesses and skilled workers that the Tulsa region punches above its weight in being a focal point for innovation and the adoption of new technologies to meet transportation and societal challenges.

The industries representing the application of the technologies embraced by the Tulsa Mobility Innovation Strategy that we consider to be special opportunities include:

- **AUTONOMOUS AND SEMI-AUTONOMOUS AERIAL SYSTEMS**
  - Drones used in agriculture and the oil and gas sector for system management and inspections.
- **AUTONOMOUS AND SEMI-AUTONOMOUS MATERIALS HANDLING SYSTEMS**
  - Robotic systems in agriculture (crop planting, harvesting, field management) and transportation (autonomous cargo handling in marine, air, and land transportation)
- **AUTONOMOUS/REMOTE-OPERATED MARINE SYSTEMS**
  - The Port of Catoosa could be an excellent test bed for autonomous and remotely operated barge systems
- **AUTONOMOUS/SEMI-AUTONOMOUS TRANSIT SYSTEMS**
  - Within district, fixed route electric and/or autonomous people movers
  - On-site employee transportation (port/airport)
- **ELECTRIC-POWERED VEHICLES AND COMPONENTS**
  - Components and parts for the rapidly growing electric vehicle market
  - Repair and maintenance hub for electric commercial and industrial vehicles
- **INTELLIGENT TRANSPORTATION SYSTEMS (ITS) INC. ROADSIDE SENSING UNITS AND ON-BOARD SENSING UNITS**
  - Supporting technology and systems developers and manufacturers
  - Test beds for next generation ITS using 5G network capabilities
- **MICRO-MOBILITY SYSTEMS**
  - Intra-district mobility systems
  - Supporting infrastructure for smart and intelligent transportation interfaces with micro-mobility

- **NETWORK INFRASTRUCTURE**
    - Wired and wireless systems supporting ITS and other mobility innovations
- **SHARED MOBILITY**
    - Mobility-as-a-Service systems

The table below provides examples of firms representing these special opportunities. This list is illustrative and does not attempt to offer a comprehensive listing of firms or related industry sectors. However, the included firms are listed with the basis for exploring business recruitment opportunities in Mobility Innovation.

Company	City	State
Innovation Line	Culver City	CA
DG World	Dubai	UAE
Precision Hawk drones	Raleigh/Virginia Beach	NC/VA
Kespry	Menlo Park	CA
AgEagle	Neodesha	KS
Raven Industries/Dot Technology Corp.	Sioux Falls	SD
JobyAviation	Santa Cruz	CA
Pony AI	Freemont	CA
Gentex	Zeeland	MI
Metawave	Palo Alto	CA
AurriGo	Houston	TX
Draper	Cambridge	MA
Port Liner		Netherlands
Kongsberg		Norway
Shone	San Francisco	CA

Details shown at the end of this Appendix

C1.10 INNOVATION ECOSYSTEM

This section summarizes the Tulsa region "innovation ecosystem." Recognizing that this topic could include many different subject areas, the innovation ecosystem is generally described for this purpose as a function of (at least) the following contributing factors:

- Commitments to innovation as reflected in various planning documents
- Institutional (excluding education) assets that support innovation
- Educational institution assets, including their role in supporting the local "power sectors" identified by regional economic developers
- Examples of makerspaces in the Tulsa area
- Venture capital firms and organizations in the Tulsa area and Oklahoma
- Employment in high-tech industries in the Tulsa region, according to a standardized definition of such industries, and other geographic-distribution aspects of the Tulsa region economic base
- Tulsa's commercial neighborhoods that can support creative reuse of the existing built environment by entrepreneurs and other innovators

COMMITMENTS TO INNOVATION AS REFLECTED IN VARIOUS PLANNING DOCUMENTS

2018-2022 Comprehensive Economic Development Strategy (CEDS)

Introductory paragraphs to the CEDS Action Plan section include the following language:

"Clean community environments and sustainable cities are rapidly becoming a desired trademark of vibrant regions. The degree of sustainability in communities can be a significant attribute for strategies to encourage foreign direct investment. Green technologies are increasingly embraced by citizens, businesses, and governments. The CEDS recognizes that choices for new and existing businesses and residents require future-oriented activity, including diverse, alternative modes of transportation and development of autonomous and connected vehicle technology and systems."[7]

Tulsa Comprehensive Plan[8]

The Plan discusses how Smart Parking, including shared parking and similar concepts, will help optimize land use and increase walkability in newly developed areas (page 29). Three potential "new centers" are identified in the Plan, in addition to a revitalized Downtown, that will be "designed to provide people with access to many goods and services in a relatively small area." The three centers (page 21) are:

1. Northland, located at 36 Street North and Peoria Avenue, which will leverage several existing assets in the surrounding area, including the Tulsa Technology Center.
2. Eastgate Metroplex, at East 21st Street and the South 145th E. Avenue, which is an existing employment center previously converted from a retail shopping mall.

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[7] INCOG. 2018-2022 INCOG EDD Economic Development Plan: *Comprehensive Economic Development Strategy* (CEDS). 2018. Page 11.

[8] PLANiTULSA. Tulsa Comprehensive Plan. July 2010; updated August 2016. Page 11.

3. Southwest Tulsa centered near the intersection of Southwest Boulevard and West 41st Street on the west side of the Arkansas River. The area includes RedFork Main Street, Tulsa's first National Main Street program area.

City of Tulsa Action and Implementation Management (AIM) Plan

The AIM Plan is a tool to communicate the priorities and goals of elected officials and senior leadership within the City to the staff and community partners. Plan strategies are organized under the two major headings of: 1) Opportunities, and 2) Well-Being.

1. Opportunities:

- AIM Education – Foster and encourage the completion of education necessary to succeed in a skilled labor market, including offering internships and job shadowing to students.
- AIM Jobs – Add jobs and expand the workforce by, among other things, aligning City economic development tools and incentives with job creation goals and industry targets, and ensuring Tulsa has adequate real estate options for primary job growth sites.
- AIM Transportation – Provide access to jobs with accessible transportation options, including through measures such as: 1) Improving transit connectivity between housing, jobs, and services; 2) Conducting small area planning to encourage infill development in underdeveloped areas; 3) Ensuring that City transportation infrastructure and policies can support evolving mobility options; and 4) Aligning City processes and policies to support development of affordable and attainable housing.

2. Well-Being:

- AIM Resiliency – Improve community resiliency with a focus on racial equity, which will be aided by completing and implementing the Community Resiliency Plan.
- AIM Physical Health – Improve Tulsans' overall health with a focus on reducing health disparities, including efforts to increase walkability and bikeability, and improving parks while also encouraging their use.
- AIM Mental Health – Address mental health issues for Tulsa's residents.

Osage Nation Strategic Plan Comprehensive Update. November 2017

The strategic plan describes how Osage Nation partnered with Tri-County Tech to create the Pawhuska Business Development Center to attract and support more local Osage-owned businesses. Innovation-related grants awarded to the Nation and described by the strategic plan include:

- A grant to develop a feasibility study for the use of the Downtown Tulsa Airpark, which not only includes recommendations for the best use of the airpark but also for the commercial and light industrial development surrounding the facility.
- A Smart Growth Technical Assistance grant to develop a plan for infrastructure assessment and strategies for the Revitalization of the Downtown District of Pawhuska.

Muscogee Nation Business Enterprise Brochure

Muscogee Nation Business Enterprise (MNBE) has a professional services division with multiple missions:

- **Enterprise Information Technology for Institutions, and Project/Program Management for Enterprises.** Working with international operating guidelines and standards to support customers in enterprise-wide missions in multiple facilities across the nation/world.
- **Scientific and Research Support.** Providing a range of technical occupational skill, for firms conducting medical and scientific research at the highest levels.

INSTITUTIONAL ASSETS THAT SUPPORT INNOVATION

The inventory of institutional assets that support innovation in the Tulsa region is summarized in the following series of tables under six headings:

A. Organizations with a focus on research and development
B. Organizations that support entrepreneurial business activity in various ways.
C. Support organizations that potentially provide funding as well
D. Organizations that have some direct role in initiating or “institutionalize” innovation
E. Economic assets involved in education, job training, and/or business networking
F. Federal programs that support business development and economic conversion

The assets are shown on the map following the series of tables. The indicators on the map match the table numbering system for the table headings and individual listings.

Key	Group, Description	Web Link
A.	Research & Development	
A.1	New Product Development Center (NPDC)	www.ceat.okstate.edu/npdc/
	The mission of the Center is to link the innovative ideas and capabilities of Oklahoma's small- and medium-sized manufacturers with the knowledge and technical expertise of the land grant university faculty, staff, and students. This collaboration fosters the development and commercialization of economically competitive new products and improves manufacturing practices.	
A.2	Oklahoma Inventor's Assistance Service (IAS)	www.npdc.okstate.edu
	The IAS is a non-profit, state-funded service that helps Oklahoma inventors navigate the invention process from idea to the marketplace through education, information, and referrals.	
A.3	Ronnie K. Irani Center for the Creation of Economic Wealth (iCCEW)	www.ou.edu/iccew
	iCCEW specializes in technology commercialization, software business development, social entrepreneurship, and agile product design.	
A.4	Oklahoma Manufacturing Alliance	www.okalliance.com
	The Alliance offers technical assistance and business advice, helping companies become progressively more successful through a statewide network of manufacturing extension agents and applications engineers.	
B.	Business Infrastructure	
B.1	George Kaiser Family Foundation	http://www.gkff.org//what-we-do/vibrant-inclusive-tulsa/economic-development/
	The Foundation invests in transformative public spaces, family well-being, and strategic economic development opportunities to increase community-wide engagement and economic opportunity.	
B.2	36 Degrees North	www.36degreesnorth.co
	Provides a high-quality workspace for startups, small business owners, remote workers, and innovative community leaders.	
B.3	The Forge	https://www.theforgetulsa.com/
	Helps entrepreneurs with proven business models cultivate their ideas into successful, scalable businesses. Workspaces are available in downtown Tulsa's Deco District.	
B.4	Oklahoma Business Incubator Association (OBIA)	www.okbia.org
	Prioritizes the needs of entrepreneurs and brings value to early stage businesses.	

B.5	Pawhuska Business Development Center	www.tricountytech.edu/pawhuska-development
	Designed to generate economic development in Pawhuska and Osage County. The primary focus is to provide incubator services in addition to classroom, meeting, and conference room space for the area.	
C.	Business Infrastructure plus Potential Funding	
C.1	Creative Oklahoma	www.creativeoklahoma.org
	Statewide nonprofit organization whose mission is to foster the development of a vibrant, creative, and innovation-based economy.	
C.2	Tulsa Economic Development Corporation	www.tedcnet.com
	Makes direct loans and participates with other financial institutions on small business projects that fall short of conventional lending standards.	
C.3	Oklahoma Health Research Program (OHR)	www.ok.gov/ocast/FUNDING_OPPORTUNITIES/Pro-Health.html
	OHR competitively awards seed funds for research projects related to human health to Oklahoma Universities and colleges, non-profit research foundations and commercial companies in Oklahoma. These federal grant programs are administered by OCAST.	
C.4	i2E (Innovation to Enterprise)	www.i2e.org
	I2E invests in entrepreneurs to build successful high-growth companies in Oklahoma. Program for start-up technology businesses that helps foster talent and business needs of aspiring entrepreneurs in the region. Serves as lead organizer for Tulsa's branch of 1 Million Cups.	
C.5	Oklahoma Innovation Model (OIM)	www.okalliance.com/who-we-are/oklahoma-innovation-model/
	A partnership formed by the following four entities featured elsewhere in this table: 1) Oklahoma Center for the Advancement of Science and Technology (OCAST), 2) Oklahoma Manufacturing Alliance, 3) i2E (Innovation to Enterprise), and 4) New Product Development Center (NPDC). Together, these organizations provide an integrated solution for innovation.	
D.	Initiating and Institutionalizing Innovation	
D.1	American Electric Power – Public Service Company of Oklahoma (AEP-PSO)	www.psoklahoma.com/global/utilities/lib/docs/environment/PSO_InnovatingforaBoundlessEnergyFuture-2019.pdf
	Power company local and regional grid modernization investments to make distributed energy production and electrification for buildings, transportation systems, and industrial processes.	
D.2	Lynn Health Science Institute	www.lhsi.net
	An innovative leader in clinical trials and comprehensive medical research studies.	

D.3	Tulsa Innovation Labs	www.tulsainnovationlabs.com/
	Founded (through Kaiser) to develop a city-wide strategy for Tulsa tech-sector growth. Focused tech sectors include virtual health, energy tech, drones, cybersecurity, and analytics (e.g., artificial intelligence, machine learning)	
D.4	Oklahoma Bioscience Association (OKBio)	www.okbio.org
	A statewide membership organization exclusively dedicated to the growth of Oklahoma's bioscience sector.	
D.5	University of Oklahoma Energy Institute	www.ou.edu/price/energyinstitute/research
	The Energy Institute was created as a research arm of the College of Business to explore energy solutions that will drive key decisions for energy companies and energy policy makers. In addition to leadership in rigorous energy research, the Institute fosters energy scholarship with a global perspective.	
D.6	Tulsa's Future	www.tulsachamber.com/tulsasfuture
	Northeast Oklahoma's regional economic development partnership, supported by public and private investors and led by the Tulsa Regional Chamber. The partnership leverages innovative strategies to enhance the Tulsa region's standing as a place for business, residents, visitors, and students of all ages. The Chamber received a *2019 IEDC Excellence in Economic Development Awards* Silver award and a Gold award in 2020, for digital marketing campaigns with local digital marketing firm, Gitwit, as well as another award in 2020 for promoting tribal partnerships.	
D.7	Oklahoma Center for the Advancement of Science and Technology (OCAST)	www.ok.gov/ocast/
	OCAST's mission is to diversify and expand Oklahoma's economy through strategic investment in technology – its development, transfer, and commercialization. The agency helps to increase research activity and public/private partnerships. The Oklahoma Applied Research Support Grant program helps universities, foundations and businesses fund cutting-edge research that will benefit Oklahoma's economy.	
D.8	North Tulsa Economic Development Initiative (NTEDi)	https://www.ntedi.net/
	NTEDi provides leadership for the north Tulsa community in economic development endeavors, and to improve the wellbeing and quality of life for individuals in the community.	
D.9	The Riata Center for Entrepreneurship – Oklahoma State University	www.business.okstate.edu/riata
	The Riata Center is dedicated to high impact entrepreneurial outreach on Oklahoma State University's campus, in the region, around the State of Oklahoma, and across America. The Center is intimately engaged with the entrepreneurial community, and strongly committed to creating unique experiential learning opportunities for students.	

E. Education/Training/Networking		
E.1	Tulsa Young Professionals (TYPros)	www.typros.org
	Focus is on attracting and retaining young creative talent in the Tulsa region.	
E.2	Rural Enterprises, Inc. (REI)	www.reiok.org
	REI Oklahoma works with partners across the state to create opportunities and provide resources to individuals, businesses, and entrepreneurs, Including technical assistance and training.	
E.3	The Lobeck Taylor Family Foundation	www.lobecktaylor.com
	Curates targeted programs to build a diverse and innovative environment for Tulsa that both attracts and retains entrepreneurs. Provides educational opportunities, networking prospects, and many other resources.	
E.4	OneOCII	www.oneocii.okepscor.org/about/
	A statewide all-inclusive advanced digital services collaboration that has been providing access to Cyberinfrastructure (CI) resources, as well as expertise and education to more than 100 institutions and organizations statewide.	
E.5	Oklahoma Small Business Development Center (OSBDC)	www.oksbdc.org
	OSBDC's mission is to ensure that all Oklahomans have access to professional and confidential business counseling, educational workshops, and continuing support throughout their business ventures.	

F. Economic Assets that Could be a Focus of Innovation Activity		
F1.	Port of Catoosa	www.tulsaport.com
	Located at the head of navigation for the McClellan-Kerr Arkansas River Navigation System in Northeast Oklahoma, it is one of the largest, most inland river ports in the United States. Agricultural commodities, building materials, and petroleum products or machinery can be shipped in and out of the Port using a combination of barge, rail, and truck. 70 companies, collectively, employing nearly 3,000 workers, are currently located within the 2,000-acre industrial park at the Port.	
F2.	Tulsa International Airport	www.tulsaairports.com
	Provides facilities and services that maximize airline service and support the growth of Tulsa's aerospace industry, including aviation maintenance, manufacturing, and training.	

G. Federal Programs that Support Business Development and Economic Conversion

G.1	American Apprenticeship Act	www.congress.gov/bill/115th-congress/senate-bill/862
	This bill directs the Department of Labor to make grants to assist states to pay for the cost of carrying out projects that defray the cost of instruction associated with pre-apprenticeship and apprenticeship programs.	
G.2	Career Advancement Through New Skills Act	www.congress.gov/bill/115th-congress/house-bill/4088
	This bill amends the Internal Revenue Code to allow a tax credit for employers that is equal to 25 percent of the qualified education and training expenses paid or incurred for employees.	
G.3	Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR)	www.sbir.gov/about/about-sttr
	SBIR and STTR are competitively awarded federal programs designed to stimulate technological innovation and provide opportunities for small businesses. These federal grant programs are administered by OCAST.	

Table series sources: websites as noted in table and www.publicradiotulsa.org/post/tulsa-innovation-labs-announces-areas-focus-tech-hub-50m-backing

Note that a number of these institutional assets include the administration of federal grants among their activities, many of which inject dollars directly into the region's innovation ecosystem. For example, OCAST administers grants for applied research (Oklahoma Applied Research Support Grant program), including those specifically targeting small businesses (SBIR and STTR), and research projects related to human health through the Oklahoma Health Research Program.

Institutions of higher learning also receive federal grant funding for a variety of purposes (see following section).

INSTITUTIONAL ASSETS IN ECONOMIC DEVELOPMENT

In addition to INCOG, several other economic development organizations are active in the region, and these also support the generation of innovative economic activity along with other economic development. These organizations include:

- Broken Arrow Chamber of Commerce
- City of Broken Arrow's Tourism and Economic Development (TED) team
- The Broken Arrow Economic Development Corporation (BAEDC)
- Claremore Industrial and Economic Development
- Metropolitan Tulsa Chamber of Commerce
- Muskogee development
- Rogers County Industrial Development Authority
- Sand Springs Economic Development

INSTITUTIONS OF HIGHER LEARNING OR TECHNICAL TRAINING

The *Tulsa Workforce Development Area Comprehensive Five-Year WIOA Local Plan*[9] provides a comprehensive inventory of 45 institutions of higher learning or technical training in the Tulsa region. These institutions are also matched to the programs they offer that support each of the six power sectors deemed important to the region:

- Advanced manufacturing
- Aerospace
- Healthcare
- Energy
- Professional services
- Transportation and logistics

These relationships are summarized in the table below, which also distinguishes between institutions offering five or more programs related to each sector, or one to four programs.

[9] Workforce Tulsa. Tulsa Workforce Development Area Comprehensive Five-Year WIOA Local Plan. Period: July 1, 2017 – June 30, 2021.

Institutions of Higher Learning or Technical Training: Programs by Power Sector

Institution of Higher Learning or Technical Training	Power Sector					
	Advanced Mfg	Aero-space	Health-care [1]	Energy	Prof. Services	Transport & Logistics
4m Welding	X					X
Brown Mackie College			x		X	
Career Point College					x	
Central Tech	X		x	x	X	X
Clary Sage			x		X	
Community Care College					X	
Green Country Tech	X		x	x	X	x
Indian Capital Tech	X		x	x	X	x
ITT Technical Institute	x			x	x	x
Langston University—Tulsa	X		x	x	X	
National American University					X	x
New Horizon Computer Learning Center					X	
Northeast Tech	X		x	X	X	X
Northeastern State University-Broken Arrow	x		x		X	x
Oklahoma Baptist University				x	X	x
Oklahoma Health Academy			x			
Oklahoma State Institute of Technology				X		
Oklahoma State Institute of Technology - Okmulgee	X		x		x	X
Oklahoma State University Center for Health Sciences			x			
Oklahoma State University-Tulsa	x	X	x		X	x
Oklahoma Technical College	X					X

Oral Roberts University			x		X	
Platt College			x			
Roadmaster Trucking						x
Rogers State University	x		x	x	X	
Southern Nazarene University		x	x		X	
Spartan College Aeronautics & Tech	X	X				x
St. Gregory's University			x		X	
Tri-County Tech	X			X	X	X
Tulsa Community College	x	x	x	x	X	x
Tulsa Tech - Broken Arrow	X		x	x		X
	Power Sector					
Institution of Higher Learning or Technical Training	Advanced Mfg	Aero-space	Health-care [1]	Energy	Prof. Services	Transport & Logistics
Tulsa Tech – Lemley	x			x	x	x
Tulsa Tech—Owasso					x	
Tulsa Tech - Peoria	x		x			x
Tulsa Tech - Riverside	x	x	x			
Tulsa Tech - Sand Springs	x		x			
Tulsa Welding School	X			x		X
University of Oklahoma-Tulsa			x		x	
University of Phoenix-Tulsa	x	x			X	
University of Tulsa			x	x	X	
Vatterott College	x			x	x	x
Virginia College			x		x	
Wright Business School					X	
Wright Career College			x			

TABLE CELL LEGEND: **X** = 5 or more programs; x = 1 to 4 programs

1. The source document provided data in a different format from the other Power Sector categories shown on the table.

Source of Power Sector program information: Workforce Tulsa. Tulsa Workforce Development Area Comprehensive Five-Year WIOA Local Plan. PERIOD: July 1, 2017 – June 30, 2021.

Institutions of higher learning are also a source of federal grant funds that support innovation. For example, according to the OSU website,[10] in 2017 "OSU had research expenditures of more than $144 million. Federal research agencies, like the National Science Foundation and the National Institutes of Health, sponsored more than $35 million in research in 2017 and are the largest source of research funding across OSU." Additional detail on OSU grant funding provides a sense of the scale and scope of the different federal agencies and academic/research units within OSU involved in these grants in just this one institution, alone. A search of federal agencies sponsoring OSU research projects, as documented in the publication, *Fiscal year 2019 - OSU research abstracts,* is summarized in the matrix on the following page.

[10] https://go.okstate.edu/about-osu/research.html

OSU Federal Agency Grant Sponsors and Associated Programs, 2019

	Architecture	Biochemistry and Molecular Biology	Biomedical Sciences	Technology	Chemical Engineering	Civil and Environmental Engineering	Department of Management Science and Information Systems	Department of Physiological Sciences	Department of Veterinary Pathobiology	Design, Housing and Merchandising	Division of Engineering Technology	Education, Health and Aviation Research Office	Electrical and Computer Engineering	Entomology and Plant Pathology	Fire Protection Publications	Fire Service Training	Geology	Horticulture and Landscape Architecture	Human Development and Family Science	Industrial Engineering and Management	Integrative Biology	Materials Science and Engineering	Mathematics	Mechanical and Aerospace Engineering	New Product Development Center	Nutritional Sciences	Physics	Plant Biology, Ecology, and Evolution	Professional Development	Psychiatry	School of Community Health Sciences, Counseling, and Counseling Psychology	School of Educational Foundations, Leadership and Aviation	School of Teaching, Learning and Educational Svcs	Sociology	**Total**
Department of Energy Through Brookhaven National Lab																										2								**2**
Department of Energy, Fermi National Accelerator Laboratory																										2								**2**
National Academies of Sciences, Engineering, and Medicine, Transportation Research Board																					1													**1**
National Academy of Sciences					2																													**2**
National Academy of Sciences For The Federal Highway Administration						2																												**2**
National Aeronautics and Space Administration					1							4										1		2										**8**
National Cancer Institute								1																										**1**
National Institute of Environmental Health Sciences								1																										**1**
National Institute of Food and Agriculture														1				1																**2**
National Institute of Standards and Technology																								1										**1**
National Institutes of Health		2			1		1	7	4	1			1	1					5							1			2	1				**27**
National Park Service																					1													**1**
National Science Foundation	1	1	5		6	5				1	3		1							4	7	3	9	16			2	6			2	11		1	**84**
United States Department of Commerce, National Oceanic and Atmospheric Administration																								2										**2**
US Department of Agriculture										2									4							7								**13**
US Department of Agriculture-Animal and Plant Health Inspection Service									1																									**1**
US Department of Commerce, Economic Development Administration																									1									**1**
US Department of Education																			1							1							5		**7**
US Department of Energy																	3																		**3**
US Department of Health and Human Services																			4																**4**
US Department of Health and Human Services, Health Resources and Services Administration																																1			**1**
US Department of Homeland Security															1	1																			**2**
US Department of Justice																								2								1			**3**
US Department of Labor																2													2						**4**
US Department of Transportation				1		7														1															**9**
US Department of Transportation, Pipeline and Hazardous Materials Safety Administration																								1											**1**
USDA National Needs Fellowship Program														1																					**1**
USDA-National Institute of Food and Agriculture									3	2									3							7									**15**
Total	**1**	**3**	**5**	**1**	**10**	**14**	**1**	**9**	**8**	**6**	**3**	**4**	**2**	**3**	**1**	**3**	**3**	**1**	**17**	**5**	**9**	**4**	**9**	**24**	**1**	**16**	**6**	**6**	**2**	**2**	**3**	**13**	**5**	**1**	**201**

TULSA MAKERSPACES

Tulsa has a combination of nonprofit and for-profit makerspaces available. The table below summarizes characteristics of three facilities, including some of their unique aspects.

MAKERSPACES, TULSA

Name	Location	Notes
Renee F. Neuwald Trust Maker Space **tulsalibrary.org**	Downtown Central Library	Provides workspaces, equipment and software, online learning resources, events, and programs in a supportive environment with special programming throughout the year geared towards adults, teens, and children.
Hardesty Center for Fab Lab Tulsa **fablabtulsa.org**	710 S. Lewis Ave, Tulsa (Kendall-Whittier neighborhood)	Provides access to advanced manufacturing and digital fabrication tools, equipment, technology, and resources. Also offers education, community, workforce, and business programming focused on innovation, design-thinking, problem-solving, and change-making. One of over 2,000 MIT-chartered Fab Labs in more than 78 countries. Also have mobile unit. One of 12 winners of an SBA pilot grant competition in 2019.
B&K Makerspace **bk-makerspace.com**	7218 E. 38th Street, Tulsa	Provides workspace and a variety of tools and equipment, such as a CNC mill and laser cutter, on a membership basis.

VENTURE CAPITAL

Several venture capital firms and other organizations are based in Tulsa or elsewhere in Oklahoma, and some of these entities focus particularly on supporting entrepreneurs within the state, such as the Oklahoma Seed Capital Fund and SeedStep Angels. The list of firms and organizations in the following table (provided as representative examples) is based primarily on data from Crunchbase, Pitchbook, and Foundersuite.

VENTURE CAPITAL ORGANIZATIONS, OKLAHOMA

Organization	Location	Comments
Accele Biopharma	Tulsa	Venture capital firm that invests in healthcare sectors
Acorn Growth Companies	Oklahoma City	Aerospace and Defense Focus
Argonaut Private Equity Fund IV	Tulsa	A diversified global private equity fund focused on Biotechnology, CleanTech, Venture Capital
Bison Fund Management	Oklahoma City	Native-American-owned firm serving companies related to business services, motor freight transportation and warehousing, hotels and rooming houses, nursing and personal care facilities, automotive services, and telephone communications industries.
Cimarron Capital Partners	Oklahoma City	Investments are designed to produce both strategic impact and financial return.
Council Oak Partners	Oklahoma City	Oklahoma-based private equity firm that can be described as a merchant bank. Serves later-stage companies that are profitable and generating positive cash flow.
Davis, Tuttle Venture Partners	Tulsa	Invests in traditional venture capital situations as well as acquisitions and other special opportunities. Goals focused on investing in companies distinguished by exceptional management and extraordinary growth opportunities, then provides additional support to management.
MetaFund	Edmond	Focus on financing that supports underserved communities. Focus areas include: • Private Equity • Tax Credits • Credit Enhancement • Habitat Financing
Oklahoma Seed Capital Fund	Oklahoma City	Early-stage equity investments to Oklahoma businesses in industries with technologies and proprietary products, processes, or knowledge that provide high growth opportunities.
Pennington Allen Capital Partners	Tulsa	Targeted industries include manufacturing, distribution, technology, media, and service businesses.

Plains Venture Partners	Tulsa	Growth-oriented venture fund focused on investing in entrepreneurs and technologies with a strong potential for disruption.
SeedStep Angels	Tulsa	Described as a group of accredited angel investors comprised of successful entrepreneurs and business leaders in Oklahoma.
Spur Capital Partners	Bartlesville	Focus on early-stage technology and life sciences.

HIGH-TECH INDUSTRIES IN THE REGION

The Tulsa region's industry mix exhibits a strong presence of high-tech industries. Table 1 shows the employment figures for high-tech industries as defined by the Bureau of Labor Statistics (BLS) in a 2015 study.[11] The BLS high-tech industry research effort used Science, Technology, Engineering and Mathematics (STEM) occupations as the starting point for deriving a high-tech industry definition and list. Specifically, the process identified industries in which concentration levels of STEM occupations were 5 times greater than the national average (a second set of industries was identified with a STEM concentration 2.5 times greater than the national average). Although numerous other methods by which to define high-tech industries are conceivable, the BLS process allows for a standard by which to compare different places across the country. The Table 1 figures include industries representing only the more rigorous definition of STEM concentration, at 5 times the national average.

High-Tech Industries and Employment in the Tulsa Region

NAICS	Industry	Jobs	Avg Ann Wages	LQ	5-Yr Job Chng	EV Link
MANUFACTURING						
3341	Computer and Peripheral Equipment Manufacturing	15	$65,126	0.03	6	
3342	Communications Equipment Manufacturing	172	$62,258	0.67	56	X
3344	Semiconductor and Other Electronic Component Manufacturing	85	$118,927	0.08	-8	X
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1,511	$66,180	1.21	69	X

[11] Bureau of Labor Statistics, Workforce Information Council, High-Tech Study Group. *High-Tech Industries In The U.S. Economy*. Fall 2015.

3346	Manufacturing and Reproducing Magnetic and Optical Media	8	$45,469	0.20	-6	
3364	Aerospace Product and Parts Manufacturing	8,673	$88,252	5.52	4,115	X
INFORMATION						
5112	Software Publishers	243	$99,493	0.18	5	X
5182	Data Processing, Hosting, and Related Services	280	$96,251	0.26	-55	
5191	Other Information Services	747	$40,927	0.51	71	
PROFESSIONAL, SCIENTIFIC, AND TECHNICAL SERVICES						
5413	Architectural, Engineering, and Related Services	5,632	$78,522	1.15	181	X
5415	Computer Systems Design and Related Services	3,480	$73,178	0.51	1,656	X
5417	Scientific Research and Development Services	133	$96,905	0.06	-73	X
	TOTAL for Sector Group	20,979			6,017	
	As % of all employment	4.4%			30.7%	

Source: JobsEQ

The category of Aerospace Product and Parts Manufacturing (3364) clearly dominates the set of high-tech industries in terms of absolute numbers, growth in the last five years, and LQ value. Several other characteristics of the high-tech industry list are particularly noteworthy. First, the 2019 employment figures in the table indicate that high-tech industries constitute 4.4% of total employment in the Tulsa region. The BLS study reported that core high-tech industries make up an average of 4.2% of total state employment across all states, indicating the figures for the Tulsa region compare well, nationally. The table also shows that employment growth for the previous five years in high-tech industries constituted 31% of industry growth in the region for all industries (again, with Aerospace leading the way), a rate much higher than the 2019 baseline percentage. Finally, of the 12 industries in the table, eight are synonymous with autonomous vehicle industries as defined elsewhere for this study.

OTHER GEOGRAPHIC-DISTRIBUTION ASPECTS OF THE TULSA REGION ECONOMIC BASE

Not included in the high-tech set is Motor Vehicle Manufacturing (3361), which is not a high-employment sector in Tulsa, with 180 employees. It has, however, seen strong growth in the last five years (just under 40%) and has a relatively high LQ of 1.64. Geographically, Tulsa is centrally located with respect to North American automotive production. For example, trade in automotive goods between the Detroit area and Kansas City, and 10 Mexican cities, totaled

$3.5 billion in 2010, according to a Brookings Institution study.[12] Similarly, electric vehicle (EV) production specifically is distributed throughout the US, in California (Tesla), Michigan (Chevy Bolt), and Tennessee (Nissan Leaf), with recent announcements of new manufacturing plants for Lucid automobiles and Nikola hydrogen fuel cell electric trucks in Arizona, and Lordstown Motors electric pickup trucks in Lordstown, Ohio. Batteries for electric vehicles are in production in Nevada (Tesla) and Ohio (GM). Arizona is also a focus of autonomous vehicle testing.

According to some sources,[13] the United States has a disadvantageous position in EV innovation and production (particularly regarding components in the supply chain). A major issue for the US economy, consequently, is whether the nation can increase its competitiveness, which may require developing and implementing a national strategy directed to relevant economic sectors as other nations have done. To the extent states or local areas can take on their own strategic initiatives with respect to electric and autonomous vehicle innovation, this can both encourage the adoption of national policies and, in the interim, bypass lack of initiative at the federal level.

The 2018 INCOG CEDS (page 7) maps the industry clusters of particular interest to the Tulsa region. Clusters are found throughout the region and in varying concentrations at particular locations: Advanced Manufacturing in the industrial parks at Broken Arrow, Health & Life Sciences near the interchange of Creek Turnpike and Mingo Valley Expressway, Aerospace near the Airport, and Telecommunications northeast of Tulsa on Highway 75. Most of the clusters are represented in the heart of Tulsa and its downtown area (other clusters include Professional Services, Energy, Logistics, and Information Technology).

COMMERCIAL NEIGHBORHOODS IN THE HEART OF TULSA AND CREATIVE REUSE OF THE EXISTING BUILT ENVIRONMENT

A previous discussion under the heading “Commitments to Innovation as Reflected in Various Planning Documents” referred to 3 potential “new centers” intended to be designed for urban-scale living and working; these areas would presumably be attractive to creative entrepreneurs. The City of Tulsa has also recognized eight Historic Commercial Districts in the heart of the community,[14] six of which are in the Downtown area bordered by Interstate 244 and Highway 75. These six historic districts represent early commercial assets in the area that were developed from the very early 20th century through as late as 1970. The six districts in the heart of Downtown are briefly described below:

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[12] Joseph Parilla and Alan Berube. *Metro North America: Cities and Metros as Hubs of Advanced Industries and Integrated Goods Trade*. Global Cities Initiative, a Joint Project of Brookings and JPMorgan Chase (undated).

[13] UAW research. *Taking the high road, strategies for a fair EV future*. Spring 2019. https://uaw.org/wp-content/uploads/2019/07/EV-White-Paper-Spring-2019.pdf. Accessed 12/20/2019. A publication of The International Union, United Automobile, Aerospace and Agricultural Implement Workers of America.

[14] INCOG website, https://incog.maps.arcgis.com/apps/Shortlist/index.html?appid=1b201fe3c56d4629a8d632507e2abe22

Downtown Historic Commercial Districts

Historic District	Primary Feature and Historic Reference
Blue Dome	Built in response to early railroad development. Route 66 came later, but the official route was moved in 1933. Area was affected by Urban Renewal.
Brady	Built in response to early railroad corridors and included Main Street commercial and logistics-related structures. Has become a vibrant arts center.
KATY Railroad	Another railroad-inspired area, with few buildings surviving since the removal of most of the rail lines in the 1950s and 1960s.
North Cheyenne Avenue	The earliest railroad-related district in Tulsa, dating from a line that arrived in the city in 1882. The BNSF railroad still operates through the area.
Oil Capital	Historic heart of Tulsa's business community, with the buildings mirroring national trends in architecture and urban design over the period 1913-1967, perhaps most notably including the Art Deco style. This area encapsulates the real estate results of the oil boom in Tulsa.
Tulsa Civic Center	An unusually notable collection of mid-century modern civic buildings all constructed within a 14-year period, intended to convey a sense of a unique urban public environment. The complex of buildings received international attention from the architectural world, enhancing Tulsa's image as a modern and progressive city. The complex remains heavily used.

While the Civic Center complex is an important symbol of Tulsa civic pride, the presence of the other districts encourages creative reuse of historic resources, building-by-building and also at a neighborhood level. Two other historic districts, Whittier Square and Sixth Street, are located east of Downtown less than 1-¼ mile away and represent additional redevelopment/reuse opportunities.

Historic and other specially designated areas could also help support the creation of "innovation districts," areas that encourage occupancy by a diverse set of entrepreneurs that potentially have linkages with local research and other institutions while increasing the physical location's potential for interactivity (see Appendix A). At least two innovation districts are under discussion in the Tulsa area:

1. The Tulsa Cyber District, which is intended to take advantage of Tulsa's existing cybersecurity assets, including the University of Tulsa along with other partners. The Tulsa Enterprise for Cyber Innovation, Talent and Entrepreneurship (TECITE), would have four Centers of Excellence, an Engineering Research Center, a Multi-Federal Agency Cybersecurity Center for Excellence, a Cybersecurity Insurance Institute, and a

Consortium of Business Sectors. The intended location would be along Tulsa's 6th Street Opportunity Zone Corridor.[15]

2. A research and development innovation district in Broken Arrow, with a goal to bring local, national, and international companies to the area to open new research facilities. Broken Arrow Public Schools is partnering with the City on the project, as well as Tulsa Technology Center and other area universities.[16]

Innovation district concepts may be emerging in Downtown Tulsa on an informal basis. According to a recent post on Inc.com, Downtown Tulsa now houses many of the community's new entrepreneurial support organizations.[17]

[15] Oklahoma Insurance Department. "Commissioner Doak Applauds University of Tulsa Effort to Create Tulsa Cyber District," CISION/PRNewswire. Jan. 10, 2019. https://www.prnewswire.com/news-releases/commissioner-doak-applauds-university-of-tulsa-effort-to-create-tulsa-cyber-district-300776659.html

[16] Fox 23 News. "Planned 'Innovation District' for Broken Arrow could be game changer." January 4, 2018. https://www.fox23.com/news/planned-innovation-district-for-broken-arrow-could-be-game-changer/676508294/. Accessed March 19, 2020.

[17] Emily Canal. "Tulsa's Oil Industry Has Been Booming for Decades. Now Its Startup Scene Is Too." Inc. Accessed March 19, 2020. https://www.inc.com/magazine/202002/emily-canal/tulsa-oklahoma-startup-entrepreneur-hub-2019-surge-cities.html

INNOVATION DISTRICTS AND THE SMALL CITY/SUBURB

The subject of Innovation Districts is given detailed treatment by the Global Institute on Innovation Districts (www.giid.org). The label is fairly self-explanatory, and for large central cities the formula for achieving a district is greatly oversimplified. This is to encourage areas where a diverse set of entrepreneurs have clustered to grow linkages with research and other institutions, while increasing the physical environment's potential for interactivity (beyond what is already likely to be an advantageous dense urban setting).

Suburbs or independent small cities may find it beneficial to promote the concept of innovation districts with particular consideration of the following:

- If expanding opportunities for technology-focused entrepreneurs is a strategic goal, the innovation district would be a supportive environment for this.
- Tech entrepreneurs are also likely to be attracted to a place with interesting housing options and workspace options, with affordability of either or both also being a factor.
- Conditions that can support an innovation district include the following:
    - What established industries in the community are likely to be calling for tech-based innovations? There are few *industries* today to which this question does not apply, even if it does not apply to all local *firms*.
    - Are there institutions of higher learning in the community or nearby that have research-oriented capabilities?
    - While having one or more local industries that are well represented in the community (e.g. high Location Quotients) is generally considered a basis for working to attract *more* activity in such industries, a diverse mix of industries, especially if they have some focus in technology, can be a virtue for innovation districts and their current relative strength in the community (LQ values may be low) is not important.
    - Are there underutilized commercial or industrial areas in the community that could be repurposed for use by small startup ventures? To the extent such areas exist, are there urban planning/design improvements that could be made to potentially benefit a range of business types, including but, not necessarily exclusively, the innovation district concept? These kinds of improvements should include expanding transportation options, streetscapes and beautification, enhanced public spaces and programmed activities, programs to encourage building upgrades, and policies to generally maximize building, site, and area usability.

From a strategic-planning standpoint, note that establishing (or encouraging) an innovation district crosses over several topical areas, including entrepreneurial development, economic diversification, area revitalization, leveraging institutional assets, housing diversification, and quality of life enhancements.

(Adapted from a contributing author's blog post)

Company List by Prime Sector. Companies or locations listed have 300 or fewer employees.

Company Name	Website	Address 1	City	State	Zip	Phone
Electric Motors and Components						
Connector Manufacturing Co	www.Cmclugs.com	3501 Symmes Road	Hamilton	OH	45015	513-860-4455
Globe Motors	www.Globe-Motors.Com	495 Commerce Drive	Amherst	NY	14228	716-242-7535
Southwire Co	www.Southwire.Com	not listed	Carrollton	GA		770-832-4242
ABB Inc	www.Abb.Com	305 Gregson Drive	Cary	NC	27511	262-238-1262
Cummins Rocky Mountain LLC	www.Cumminsrockymountain.Com	Box 3005	Columbus	IN	47202	800-286-6367
Keller Electrical Industries	www.Kellerelectrical.Com	1881 East University Drive	Phoenix	AZ	85034	602-437-3015
Southwest Products Corp	www.Southwestproducts.Com	11690 N 132nd Ave	Surprise	AZ	85379	623-544-4927
Alturdyne Power Systems LLC	www.Alturdyneint.Com	660 Steele St	El Cajon	CA	92020	619-593-0757
Anritsu Co	www.Anritsu.Com	5-1-1 Onna, Atsugi-shi, Kanagawa 243-8555, Japan	Atsugi	Japan		
Eaton Cooper Interconnect	www.Cooperindustries.Com	9650 Jeronimo Road	Irvine	CA	92618	949-452-9500

Electric Motor Shop	www.Electricmotorshop.Com	253 Fulton Street	Fresno	CA	93721	559-650-1153
Hawthorne Power System	www.Hawthornecat.Com	16945 Camino San Bernardo	San Diego	CA	92127	858-674-7000
L3harris Power Paragon Inc	www.L3harris.Com	1025 W. NASA Boulevard	Melbourne	FL	32919	321-727-9100
Mechanical Analysis Repair Inc	www.Mar-Tech.Com	142 North Cliff Ave	Lodi	CA	95240	209-333-8478
Peterson Power Systems	www.Petersonpower.Com	2828 Teagarden St	San Leandro	CA	94578	510-206-2114
Polar Power Inc	www.Polarpower.Com	249 E Gardena Blvd	Gardena	CA	90248	310-830-9153
Environmental and Technical Consulting						
Contact Network	www.Uniti.Com	10802 Executive Center Drive, Benton Bldg. Suite 300	Little Rock	AR	72211	501-850-0820
Deshazo Automation (Decatur, AL)	www.deshazo.com	200 Kilsby Circle	Bessemer	AL	35022	800-926-2006
Benchmark Group	www.Teamofchoice.Com	1805 N 2nd Street	Rogers	AR	72756	479-636-5004
Agjunction Inc	www.Agjunction.Com	9105 E. Del Camino Drive #115	Scottsdale	AZ	85258	490-348-9919
M3 Engineering & Technology	www.M3eng.Com	2051 W. Sunset Rd., Suite 101	Tucson	AZ	85704	520-293-1488
Mintec Inc	www.Hexagonmining.Com	40 East Congress St, Suite 300	Tucson	AZ	85701	520-795-3891

Securaplane Technologies Inc	www.Securaplane.Com	12350 N Vistoso Park Road	Tucson	AZ	85755	520-297-0844
Surveying and Mapping Services						
Whpacific Inc	www.Whpacific.Com	6501 Americas Parkway NE	Albuquerque	NM	87110	505-247-0294
Garver LLC	www.Garverusa.Com	1620 West Fountainhead Pkwy, Suite 503	Tempe	AZ	85282	480-646-5366
David Evans & Assoc Inc	www.Deainc.Com	2100 S River Parkway, Suite 100	Portland	OR	97201	800-721-1916
Protex The Pt Xperts LLC	www.Protex-Az.Com	1102 West Southern Ave, Suite 4	Tempe	AZ	85282	602-272-7891
Albert A WEBB Assoc	www.Webbassociates.Com	3788 McCray Street	Riverside	CA	92506	951-686-1070
BKF Engineers	www.Bkf.Com	255 Shoreline Drive, Suite 200	Redwood City	CA	94065	650-482-6300
Cannon Associates	www.Cannoncorp.Us	4540 California Ave, Suite 550	Bakersfield	CA	93309	661-328-6280
GDR Group Inc	www.Gdrgroup.Com	3 Parl Plaza, Suite 1700	Irvine	CA	92614	844-GDR-GROUP
Intellisurvey Inc	www.Intellisurvey.Com	27261 Las Ramblas, Suite 200	Mission Viejo	CA	92691	949-298-4400
Provost & Pritchard Consulting	www.Provostandpritchard.Com	286 W CROMWELL AVE	Fresno	CA	93711	559-449-2700
Psomas	www.Psomas.Com	11661 Blocker Drive, Suite 200	Auburn	CA	95603	530-885-7072

Rick Engineering Co	www.Rickengineering.Com	5620 Friars Road	San Diego	CA	92110	619-291-0707
RRM Design Group	www.Rrmdesign.Com	3765 S Higuera St, Suite 102	San Luis Obispo	CA	93401	805-543-1794
Westland Group Inc	www.Westlandgroup.Net	4150 Concours Street, Suite 100	Ontario	CA	97164	909-989-9789
Yolano Engineers Inc	www.Syar.Com	2301 Napa Vallejo Highway, PO Box 2540	Napa	CA	94558	707-252-8711
Flatirons Inc	www.Flatironsinc.Com	3825 Iris Avenue, Suite 395	Boulder	CO	80301	303-443-7001
Edminster Hinshaw Russ & Assoc	www.Ehrainc.Com	1001 Meadowglen Lane	Houston	TX	77042	713-784-4500
Loureiro Engineering Assoc Inc	www.Loureiro.Com	100 Northwest Drive	Plainville	CT	6062	860-747-6181

Aircraft Parts and Auxiliary Equipment						
CAD Enterprises, Inc.	www.cadenterprises.com	302 N. 52nd Avenue	Phoenix	AZ	85043	602-278-4407
Microsemi Corporation	www.microsemi.com	2355 W. Chandler Blvd.	Chandler	AZ	85224	480-792-7200
Northstar Aerospace	www.nsaero.com	6006 West 73rd Street	Bedford Park	IL	60638	708-728-2020
Systems 3, Inc.	http://systems3.net	1515 West 17th Street	Tempe	AZ	85281	480-894-2581
Advanced Thermal Sciences	www.atschiller.com	3355 East La Palma Avenue	Anaheim	CA	92806	714-688-4200
Ancra Aircraft Systems Division	www.ancra.com	not provided	Azusa	CA	91702	626-765-4818
Concorde Battery Corporation	www.aircraft-batteries.com	2009 San Bernardino Road	West Covina	CA	91790	626-813-1234
Datron World Communications, Inc.	www.dtwc.com	3055 Enterprise Court	Vista	CA	92081	760-597-1500
Dytran Instruments, Inc.	www.dytran.com	21592 Marilla Street	Chatsworth	CA	91311	818-700-7818
Eaton Corporation	www.cooperindustries.com	30 Pembroke Road	Dublin 4	Ireland	n/a	216-523-4400
Wetmore Tool and Engineering Co.	www.hpwetmore.com	5091 G Street	Chino	CA	91710	909-364-1000

Hydroform USA	www.hydroformusa.com	2848 East 208 Street	Carson	CA	90810	310-632-6353
Pacific Scientific Energetic Materials Company	https://psemc.com	7073 W. Willis Road	Chandler	AZ	85226	480-763-3000
Rexnord Aerospace	https://aerospace.rexnord.com/home	2400 Curtiss St.	Downers Grove	IL	60515	844-295-2376
United Drill Bushing Corporation	www.ucc-udb.com	12200 Woodruff Avenue	Downey	CA	90241	800-486-3446
Amphenol Broadband Solutions	https://www.amphenolbroadband.com	358 Hall Avenue	Wallingford	CT	06492	800-677-2288
Beacon Industries	www.beacongp.com	549 Cedar Street	Newington	CT	06111	860-594-5200
PCX AeroSystems	www.pcxaero.com	300 Fenn Road	Newington	CT	06111	860-666-2471
Dayton-Granger, Inc.	www.daytongranger.com	3299 SW 9th Avenue	Fort Lauderdale	FL	33315	954-463-3451
Radiant Power Corporation	www.radiantpowercorp.com	7135 16th Street East, Suite 101	Sarasota	FL	34243	941-739-3200
Thrush Aircraft	www.thrushaircraft.com	300 Old Pretoria Road	Albany	GA	31721	229-883-1440
Aero-Mach Labs, Inc.	www.aeromach.com	7707 E. Funston	Wichita	KS	67207	316-682-3418
Ducommun, Inc.	www.ducommun.com	200 Sandpointe Avenue, Suite 700	Santa Ana	CA	92707	657-335-3665

Enstrom Helicopter Inc.	www.enstromhelicopter.com	2209 22nd Street	Menominee	MI	49858	906-863-1200
BRS Aerospace	www.brsaerospace.com	380 Airport Road South	Saint Paul	MN	55075	651-457-7491
US Cargo Systems	www.uscargosystems.com	500-A Gateway Drive	Goldsboro	NC	27534	919-705-2585
Engineered Systems	www.engineeredsystems.com	55 New Orleans Road, Suite 200	Hilton Head Island	SC	29928	843-686-5300
Safran Electronics & Defense Quality Policy	www.safran-electronics-defense.com	French address				
Monroe Aerospace	https://monroeaerospace.com	399 East Drive	Melbourne	FL	32904	866-206-1467
Navigation and Related Equipment						
AgJunction, Inc.	www.agjunction.com	9105 E. Del Camino Dr., Suite 115	Scottsdale	AZ	85258	480-348-9919
Universal Avionics	www.uasc.com	3260 E. Universal Way	Tucson	AZ	85756	520-295-2300
Del Mar Avionics	www.dma.com	11-B Marconi	Irvine	CA	92618	949-250-3200
JAVAD	www.javad.com	900 Rock Avenue	San Jose	CA	95131	408-770-1770
Computrol	www.computrol.com	499 E. Corporate Dr.	Meridian	ID	83642	208-887-1000
Trimble MAPS	www.alk.com	1 Independence Way	Princeton	NJ	08540	n/a

OHAUS Corporation	https://us.ohaus.com/en-us/	7 Campus Drive, Suite 310	Parsippany	NJ	07054	800-672-7722
Orbit International Corporation	www.orbitintl.com	80 Cabot Court	Hauppauge	NY	11788	631-435-8300
Industrial Processes and Control Instruments						
Leonardo DRS	www.drs.com	2345 Crystal Drive, Suite 1000	Arlington	VA	22202	703-416-8000
MSA, The Safety Company	www.generalmonitors.com	1000 Cranberry Woods Drive	Cranberry Township	PA	16066	n/a
Georg Fischer LLC	www.gfsignet.com	9271 Jeronimo Road	Irvine	CA	92618	714-731-8800
Maury Microwave Corporation	www.maurymw.com	2900 Inland Empire Blvd.	Ontario	CA	91764	909-987-4715
OMRON Robotics and Safety Tech.	www.adept.com	4225 Hacienda Drive	Pleasanton	CA	94588	925-245-3400
OPTO 22	www.opto22.com	43044 Business Park Drive	Temecula	CA	92590	800-321-6786
Gems Sensor & Controls	https://www.gemssensors.com	1 Cowles Road	Plainville	CT	06062	8550877-9666
DICKEY-john	www.dickey-john.com	5200 Dickey John Road	Auburn	IL	62615	217-438-3371
Endress+Hauser USA	www.us.endress.com	2350 Endress Place`	Greenwood	IN	46143	888-363-7377
Sevcon	www.sevcon.com	155 Northboro Road, Suite 1	Southborough	MA	01772	508-281-5500

Progressive Dynamics, Inc.	https://www.progressivedyn.com	507 Industrial Road	Marshall	MI	49068	269-781-4241
Banner Engineering Corporation	www.bannerengineering.com	9714 10th Avenue North	Minneapolis	MN	55441	763-544-3164

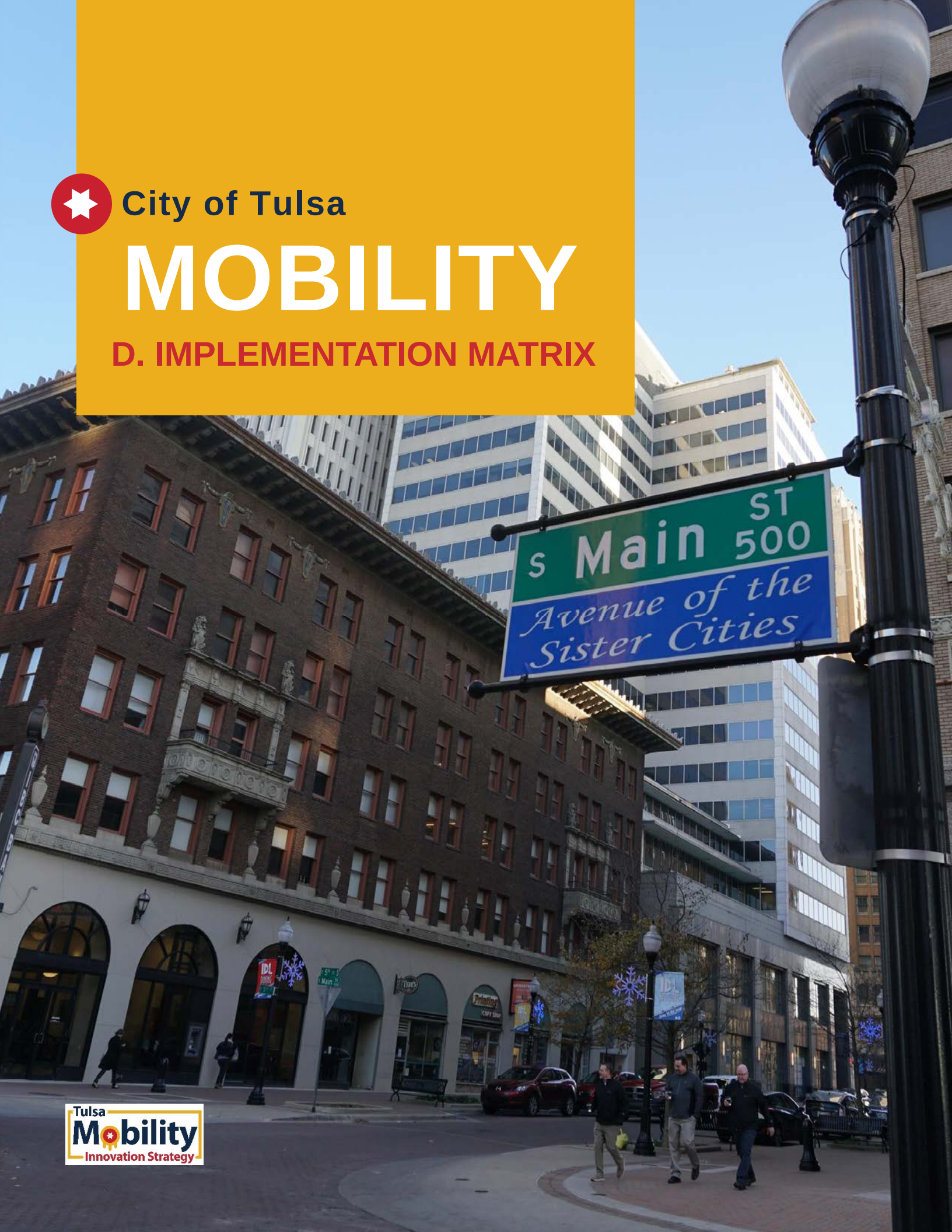
Other Sectors						
Innovation Line	www.Innovationwireless.Com	11869 Teale Street	Culver City	CA	90230	888-559-5565
DG World	www.dgworld.com		Dubai	UAE		
Precision Hawk drones	www.precisionhawk.com		Raleigh/Virginia Beach	NC/VA		844-328-5326
Kespry	www.kespry.com	4005 Bohannon Dr.	Menlo Park	CA	94025	650-324-7970
AgEagle	www.ageagle.com	117 S. 4th Street	Neodesha	KS	66757	620-325-6363
Raven Industries/Dot Technology Corp.	www.ravenind.com	205 E. 6th Street	Sioux Falls	SD		6053362750
JobyAviation	www.jobyaviation.com		Santa Cruz	CA		
Pony AI	www.pnoyai.com		Freemont	CA		
Gentex	www.gentex.com	600 N. Centennial St	Zeeland	MI	49464	616-772-1800
Metawave	www.metawave.co	1023 Corporation Way	Palo Alto	CA	94303	
AurriGo	www.aurrigo.com	10370 Richmond	Houston	TX	77042	7175037777
Draper	www.draper.com	555 Technology Square	Cambridge	MA	2139	617-258-1000
Port Liner	www.portliner.ni		Netherlands			
Kongsberg	www.kongsberg.com		Norway			

Shone	www.shone.com	67 Langton St	San Francisco	CA	94103	

City of Tulsa

MOBILITY

D. IMPLEMENTATION MATRIX



Tulsa Mobility Innovation Strategy

MOBILITY INNOVATION- EQUITY IMPLEMENTATION

CHALLENGE:
Current transit services are not convenient for all and does not reach all Tulsans who rely on it

3.1 EXPAND THE REACH OF TULSA TRANSIT WITH EXPANDED BRT, MAAS, AND MICROTRANSIT

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
A1. Implement East-West BRT line	ACTION					• Tulsa Transit • This Machine • Uber/Lyft
• AS3. Create action plan to address service gaps	▲					
A2. Build out GoPass Payment Fully	PREP	ACTION				
A3. Expand Mobility as a Service (MaaS)	PREP	ACTION				
A4. Deploy microtransit	PREP		ACTION			
• AS1. Pursue public-private partnerships		▲				
A5. Expand shared mobility and micromobility	PREP			ACTION		
• AS4. Partner with community organizations		▲				
• AS2. Initiate a pilot for mobility on demand/ miro-transit for night-time service			▲			
A6. Mobility hubs at transit hubs	PREP			ACTION		

CHALLENGE:
Low-income neighborhoods are often at a particular disadvantage to having healthy food access

3.2 IMPROVE ACCESS TO HEALTHY FOOD: GROCERY STORE MOBILITY HUBS

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
A7. Align bus service and grocery store hubs						• Grocery store owners • Tulsa Transit • This Machine • Uber/Lyft • Tulsa Health Department • INCOG
• AS5. Designate preferred locations	▲					
• AS8. Partner with rideshare providers	▲					
• AS9. Install lockers for essential supplies	▲					
• AS6. Initiate a pilot project	▲					
• AS7. Fund Tulsa Transit to fill system gaps	▲					
A8. Enable electric vehicle (EV) shuttle connections						
A9. Expand micromobility						
A10. Initiate automated delivery pilots						

▲ Indicates short-term action supporting key strategy

CHALLENGE:
More options are needed for people who do not own a personal vehicle

3.3 REMOVE WALK, BIKE AND Micromobility BARRIERS

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
A11. Change funding priorities						• Tulsa Transit • Tulsa Housing Authority
A12. Implement tools for increased walk safety						
• AS11. Continue walkability projects	▲					
• AS12. Decriminalize jaywalking		▲				
A13. Expand bicycle and micromobility infrastructure						
• AS10. Pilot protected bike lanes			▲			

CHALLENGE:
More options are needed for people who do not have access to credit or a smart phone

3.4 PROMOTE EQUITABLE MOBILITY POLICIES

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
A14. Transportation Demand Management						• Tulsa Health Department • This Machine • Tulsa Transit • Bird, Lime
• AS14. Partner with community organizations	▲					
• AS13. Ensure bilingual transportation communications		▲				
• AS15. Outreach and education program on smart mobility options			▲			
A15. Transit benefit/subsidies applied across modes						
• AS16. Subsidize shared TNC services		▲				
A16. Investment strategy prioritizing transit, bicycle and pedestrians						
A17. Land use						
• AS17. Promote smart rezoning	▲					
A18. Curb management						

▲ Indicates short-term action supporting key strategy

MOBILITY INNOVATION- POLICY IMPLEMENTATION

CHALLENGE:
Tulsa's original foundations were built around the automobile

4.1 DEVELOP INNOVATIVE LAND USE POLICIES

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
B1. Update the building code to include accessible access and parking for shared mobility						• City of Tulsa • INCOG • Land developers
• BS3. Expand parklet and curbside lane permitting programs to incentivize active walkable streetscapes	▲					
B2. Refine parking requirements to inventivize walkable mixed-use development citywide:						
• BS2. Conduct on-street parking evaluation of parking program impacts	▲					
• BS1. Conduct a parking cost evaluation		▲				
B3. Create new zoning policies that incentivize denser mixed-use development along transit and shared mobility corridors						
B4. Update Tulsa's comprehensive plan to chart transit-oriented and shared mobility nodes and corridors						

CHALLENGE:
Non-standardized data streams prevent Tulsa from facilitating a seamless and integrated mobility system across modes

4.2 LEVERAGE DATA FOR INNOVATION

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
B5. Design a data collaborative						• City of Tulsa • INCOG • Universities • Local technology innovators
B6. Develop a city-wide governance framework						
• BS4. Establish data commission	▲					
• BS5. Identify use cases for data		▲				
• BS6. Identify best practices for protecting user privacy		▲				
B7. Pilot data revenue opportunities						

▲ Indicates short-term action supporting key strategy

CHALLENGE:
AV funding and education needs to be continually pursued

4.3 ACCELERATE AV INNOVATION

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
B8. Establish City/INCOG task force to plan, fund, and evaluate AV pilots across modes						• City of Tulsa • INCOG • State of Oklahoma • Universities
• BS8. Confirm conditions of on-road operations of automated vehicles	▲					
• BS9. Convene public-private university working group	▲					
• BS10. Launch the first project in a pilot program	▲					
• BS11. Showcase Tulsa/INCOG AV readiness and mobility innovation	▲					

CHALLENGE:
Innovation leaders are largely supported by the private sector, and need more public partnerships

4.4 REMOVE LOCAL BARRIERS TO LOCAL INNOVATION

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
B9. Modernize city procurement process						• City of Tulsa • Federal Highway Administration • Downtown BID
B10. Create program of pilots to bring innovation to scale						
• BS12 Establish a mobility innovation challenge	▲					
• BS13. Catalog funding sources (public and private, federal, regional, state)	▲					
• BS14. Seek a legislative study of innovation funding and financing for transportation	▲					
B11. Develop a public-private funding plan collaboratively with private firms, universities and regional philanthropies						
• BS15. Collect best practices in innovation partnerships with regional and national foundations	▲					
B12. Support the state pilot innovation fund						
B13. Secure local/regional P-3 authorization						

▲ Indicates short-term action supporting key strategy

CHALLENGE:
Tulsa's auto-centric infrastructure puts those who use alternative modes at greater risk, by default

4.5 MAKE TULSA A LEADER OF SAFE AND SHARED MOBILITY

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
B14. Invest in safe places to walk, bike, and scooter						• City of Tulsa • INCOG • Universities and foundations • Business associations • Non-profit organizations • Tulsans citywide
• BS16. Launch walk safety assessment	▲					
B15. Initiate regular community engagement on shared mobility						
B16. Expand and connect walking and micromobility networks						
• BS17. Complete streets design guide	▲					
B17. Integrate pedestrian safety in downtown mobility programming						
B18. Expand access to micromobility						

▲ Indicates short-term action supporting key strategy

MOBILITY INNOVATION- ECONOMY IMPLEMENTATION

CHALLENGE:
Current job centers in Tulsa are not easily reached without a car

5.1 EXPAND MOBILITY CHOICES

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
C1. Foster micromobility						• City of Tulsa • INCOG • Private and university campuses • Land developers
• CS1. Convene discussions between Tulsa Transit and employers	▲					
• CS2. Review market and statutory issues		▲				
• CS3. Design an adaptable incentive policy		▲				
C2. Create safe spaces to walk/bike						

CHALLENGE:
Tulsa is a few steps away from leading the region in mobility technology

5.2 DEEPEN TALENT POOL

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
C3. Provide mobility services to colleges						• Universities • Major employers • City of Tulsa Office of Economic Development • TYPros
• CS4. Maintain scooter presence	▲					
• CS5. Continue inter-campus bus service	▲					
C4. Partner with universities and colleges to build out technical skills programs						
• CS7. Facilitate partnerships for student training		▲				
C5. Fill gaps in local supply chain components for key industries						
• CS6. Connect campuses with opportunities	▲					
• CS8. Plan for an innovation accelerator		▲				

▲ Indicates short-term action supporting key strategy

CHALLENGE:
There is existing imbalance in Tulsa's areas of economic strength

5.3 ATTRACT AND DEVELOP NEW TECH FIRMS

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
C6. Create mobility innovation centers on cybersecurity, AV freight, and logistics						• City of Tulsa Office of Economic Development • Port of Catoosa • Tulsa Airport
• CS12. Update economic development marketing plan and recruitment materials	▲					
C7. Develop a cyber district						
• CS9. Create form-based land development codes		▲				
• CS10. Create tax increment financing (TIF) districts		▲				
C8. Create multimodal testbeds for AV freight, river, airport, and drones						
• CS11. Review port management structure	▲					

▲ Indicates short-term action supporting key strategy

MOBILITY INNOVATION- PARTNERSHIP IMPLEMENTATION

CHALLENGE:
Mobility options and improvements seen on the ground are not yet interconnected

6.1 BRING INNOVATION TO DOWNTOWN STREETS

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
D1. Pioneer digital assessments of the street, curbside, and sidewalks						• City of Tulsa • Downtown Tulsa Partnership • Major employers • Technology vendors
D2. Alleviate curbside congestion with smart zones						
• DS2. Conduct an environmental scan of mobility innovation pilot opportunities	▲					
• DS3. Initiate pilot of movility data assessment for road and sidewalk safety		▲				
• DS1. Create public-private-partnership structure		▲				
D3. Pilot micromobility hubs with electric charging capabilities						
D4. Join with Tulsa Transit, campus transportation, and entertainment venues in piloting an AV shuttle pilot in multiple operating environments						
• DS5. Identify philanthropic and private sector funding opportunities	▲					
D5. Pilot first and last-mile freight delivery						
• DS4. Convene stakeholders for technology workshop pilots on automated mobility and freight		▲				

▲ Indicates short-term action supporting key strategy

CHALLENGE:
Existing parties leading innovation are not coordinating with each other

6.2 BUILDING MOBILITY INNOVATION SOLUTIONS

STRATEGIES	TARGETED TIMELINE					KEY PARTNERS
	Y1	Y2	Y3	Y4	Y5-10	
D6. Create partnership network to convert campuses and corridors to engines of innovation						• Surface transportation agencies • The Tulsa Port of Catoosa • Tulsa International Airport • Private and university campuses • Private technology vendors • City of Tulsa • INCOG
• DS6. Coordinate early stage partnerships	▲					
• DS7. Create an advisory committee	▲					
• DS8. Develop Year-One implementation plan	▲					
• DS9. Identify funding opportunities	▲					
• DS10. Grocery mobility hub pilot	▲					

▲ Indicates short-term action supporting key strategy