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## 1 Introduction & Background

### 1.1 Universities

#### 1.1.1 Creating Demand

Universities campuses in college towns provide unique opportunities to reduce transportation-related greenhouse gas emissions(GHGe) other pollutants. Interest in university student travel behavior has grown among researchers and policy makers and car dependency continues to adversely impact U.S. communities[Zhou, Wang, and Wu (2018)](**kattak2011?**). Car dependency continues to have adverse environmental, social and economic consequences on communities. including pollution, health effects, and financial burden(Romanowska, Okraszewska, and Jamroz 2019). Universities are recognized institutions that create awareness of climate change mitigation and sustainable transportation practices[(**romanowsaka2019?**)](Angelis, Mantecchini, and Pietrantoni 2021)(Zhou 2012).

Referred to as “cities inside cities” . universities are ideal learning laboratories for researching and identifying sustainability initiatives. Operating as a communal network that reflects a large community and function universities have a significant role in promoting sustainable development and tackling transportation concerns. The movement of students, students staff and visitors is a critical factor in the growing impact of universities campuses to the surrounding area. Universities have a large footprint, accounting for up to 2% of the total annual U.S. GHGe, making it important that they participate in mitigating climate change(**parsley2022?**).

University students are considered a key segment of the population those travel is often understudies and weakly covered in current literature and data collection[(**kattak2011?**)](Taylor and Mitra 2021). Current research explores daily commuting patterns, factors influencing travel behavior, and the potential for shifting toward more sustainable travel modes[Romanowska, Okraszewska, and Jamroz (2019)](**zhou2011?**).Factors affecting mode choice include physical environment(distance, time, density), mode-specific cost, accessibility to transit, personal attributes, trip characteristics, travel demand management (TDM) measures, and psychological factors( or awareness and previewed safety(Zhou, Wang, and Wu 2018).

#### 1.1.2 Trip Generation

Universities are major contributors to commuting trips averaging 20% higher than the general public, **3.69** daily tripsKhattak et al. (2011). Universities serve a large number of students and staff forming a significant portion of the local or regional population(Romanowska, Okraszewska, and Jamroz 2019). This large concentrationed populations moving from and around a campact campus inherently generate a significant volumne of daily trips(Romanowska, Okraszewska, and Jamroz 2019). (Khattak et al. 2011) defines a trip as moving at least 300 feet from one address to another. This definition is important for capturing travel behavior of university students living on and around campus. Undergraduate students living on campus make the most trips when compared to other university groups. University students make shorter non-motorized trips, utilizing walking and biking infrastructure. (Khattak et al. 2011).

#### 1.1.3 Using Alternative Travel Modes

University students transient living and wide use to travel modes, marking them as notably from the general population. University students are more likely to adopt alternative travel modes, having a higher portion versus staff and general public. Students populations tend to walk and and bike more reducing car trips. Student tend prioritize housing that is affordable and close to campus, providing them more travel mode choice. The variety of quality transportation modes and high portion of alternative transportation modes creates a need for a more comprehensive transportation system, less reliant on fossil fuels. Universities increase the demand on local transportation system while providing an opportunity to expand alternative transportation modes. Today large university campuses are a microcosm of the urban landscape and provides a ideal environment for studying transportation policy and infrastructure. (Zhou, Wang, and Wu 2018, 133)

College towns are recognized as areas where university students account for a significant share of the local population(33% or more) and tend to have smaller population sizes and a more compact urban form compared to large urban areas(Zhou, Wang, and Wu 2018). This compactness suggest students are more likely to walk or bike and drive less(Zhou, Wang, and Wu 2018). A study focused on college students commuter students were more likely to use alternative and active travel modes when compared to staff and peers at urban universities(Zhou, Wang, and Wu 2018). However, 25% of commuters students living within two miles of campus drove alone, indicating that a compact form is only the only factor of satisfying all travel needs, like out of town travel(Zhou, Wang, and Wu 2018). The advantage of shorter distances, good transit, and a safe environment are not guarantees of alternative mode, suggesting the need for further strategies to manage transportation needs(Zhou, Wang, and Wu 2018).

#### 1.1.4 Travel Factors

(**romanowka2019?**) identifies access to a vehicle, trip origin, and trip distance as key factors in travel mode choice.(Angelis, Mantecchini, and Pietrantoni 2021) finds locations and travel continuity as significantly impact mode choice. The high density at Texas State increases potential for “transport infrastructure and services” supporting multi-modal travel. Compact campus design promoted higher trip rates among students. Higher density creates more complex transportation patterns. May increase the importance of efficient multi-modal transportation systems. High students density presents both challenges and opportunities for promoting alternative transportation. Studies find that improved biking and pedestrian infrastructure reduces car commuting, to up 14%(**romanowka2019?**). University students live relatively close to campus and have accessible to quality multi-modal transportation systems(Zhou, Wang, and Wu 2018, 132) For many the university campus is the A more rigorous focus on university travel will provide insight on how the built environment combined with social factors effect travel behavior(Angelis, Mantecchini, and Pietrantoni 2021). Universities are active;ly encouraging sustainable education and practices(Parsley and Waliczek, n.d.). Students are a social group with high willingness to adopt new ideas and make lifestyle changes. The knowledge, experiences, and attitudes gain during college raise awareness in for the wider public(Romanowska, Okraszewska, and Jamroz 2019). Universities can leverage this to promote pro-environmental values and prevent the development of pro-car habits in young commuters(Angelis, Mantecchini, and Pietrantoni 2021).

#### 1.1.5 Window of Opportunity

The university is a “window of opportunity” for significant lifestyle changes, like travel behavior. Travel behavior habits are repetitive decision made in a stable state of life based on the current knowledge and perspective of available resources. Theory of planned behavior(TPB) suggest travel behavior are habits that are significant influenced by a commuters knowledge and perceptions of the available transportation system. Travel behavior is understood to give insight to commuter belief and perspectives, and attitude towards travel modes. (**deangelis2012?**) used the Value-belief-norms(VBN) understand that an individuals moral obligation to the environment can significantly impact travel mode choice. Understanding that habitual travel behaviors are based on individual morals, explains how personal experiences and attitudes can shape travel mode choice. A commuter’s knowledge and perception of the available transportation modes will decide their travel behavior.

Study suggest habits are best broken and formed most easily during transitional period of life like have a child, relocating for a new job, or going to college. During these transitional periods individuals are inevitably induced to new environments or experiences that may influence their perspectives and grow their knowledge base. Changes adopted during this “window of opportunity” are likely to effect lifestyle choice like mode choice and last into later life beyond the university campus. (**deangelis2012?**). An commuters who uses alternative transportation option during college will view biking, walking, or public transit as favorable options later in life. Where as someone who drive most of their time on campus is likely to continue with less chance of reconsidering other options. (**okrazeska?**,) find that students are more likely than staff to choice alternative and active travel modes. About 20% University staff preferred travel modes for their directness, duration, convenience and flexibility. These travel preferences are consistent with staff demographics, representing a more stable consistent lifestyle, having dependents, and living away from campus.

#### 1.1.6 Research Question

How can universities leverage physical factors of campus to reduce transportation emissions?

#### 1.1.7 Methodology

This study site is Texas State University(TXST), a premier public school institution located in San Marcos Texas. As one of seven institutions in The Texas State University System, San Marcos(main) campus serves 40,678 students today. This campus is a thriving public research institution with an annual exceeding $165 million and racing to Carnegie R1 status.

TXST is strategically located in the Texas Triangle, the dynamic regions of Texas that encompasses San Antonio, Austin, Dallas-Forth Worth, and Houston(**txcampplan24?**). This area is home to more than 70% of Texas population(>21 million people) and 80% of Texas GDP. The Texas Triangle has experienced rapid growth, reaching over 15% in the last decade. This setting provides TXST school system with direct connection to a diverse pool of talent, proximity to leading industries, and a vibrant cultural and economic environment. With seven distinct locations along the I-35 corridor between Austin and San Antonio, TSXT is uniquely positioned to serve the growing region.

San Marcos and Round Rock campuses benefit from proximity to two of Texas’s fastest-growing metropolitan areas providing a robust enrollment catchment zone and direct access to diverse industries like technology, healthcare, and manufacturing. These campus locations are ideal for building partnerships and fostering research and innovation. Along with the main campus(San Marcos) TXST has Science, Technology, and Advanced Research(STAR Park), Advanced Law Enforcement Rapid Response Training(ALERRT), Muller Farm, Freeman Ranch, and University Camp. These sites support specific functions for TXST and collectively enhance the institution’s research resources. STAR Park, which serves as an extension of the university as a research hub for enterprise and collaboration with industry partners. Muller Farm and Freeman Ranch serve as hands on leaning environments for agriculture and land management research. University Camp about 14 miles from main campus along the Blanco river offers a recreational retreat and outdoor leaning opportunities. These locations are part of the larges TXST systems and are designed to work to benefit TXST San Macros campus population.

San Marcos, Texas, is a vibrant nexus within the rapidly growing I-35 corridor. In 2023 the population was over 71,000, nearly doubling since 2000. TXST San Marcos 517 acre main campus sits in the heart of San Marcos, 3 blocks from downtown. As one of the largest employers in the area TXST plays a significant role in the region, as campus population contribute labor and consumers for local economy. San Marcos is often recognized as a noble college town, with TXST students accounting for more than half of the local population. Campus is compact, operating at around 75 assignable square foot(ASF) per full-time equivalent(FTE), suggesting a highly efficient use of space(**txcampplan24?**). San Marco’s dense urban landscape and TXST’s compact campus create a distinct opportunity for employing and assessing novel transportation interventions.

The San Marcos Campus is situated atop rolling hills that creates a unique environment adjacent to the San Marcos River and Downtown San Marcos. The campus’s unique connection to its surrounding ecology and urban context provide a memorable experiences. The campus features a 200-foot elevation change, descending from northwest to low-lying areas near Spring Lake and the San Marcos River. Old Main, perched on Chautauqua Hill overlooking the river gives a notice of the hilly topography. The San Marcos River and Spring Lake as a part of campus are crucial natural features that provide scenic views and educational opportunities. The university connection to these nature features is emphasized in tradations, such as joining your cohort at Swell park to jumping in the river after graduation.

Local Transportation assets and infrastructure

Pedestrain Circulation: TXST’s campus is a pedestrian-oriented are defined by three major east-west pedestrian axes: The Quad, Bobcat Trail, and Concho Green. TXST has a core

Parking: The university maintains a comprehensive parking network with parking garages, surfaces lots, and on-street parking. Nine parking garages are concentrated in the west and central areas near Chautauqua. However, rapid growth has created a shortage in most parking categories.

Roadways and Gateways: Key intersections like Aquarena Springs Drive and Sessom Drive serve as major gateways but experience significant congestion during peak hours. Strategies to improve traffic flow are recommended, including low-impact solutions like re striping and signal timing, though physical modifications are limited by the river and existing structures. Enhancements to streets capes and signage are proposed at gateways to strengthen the universities presence.

Transit and Mobility: The Campus Plan prioritizes enhancing physical connectivity through pedestrian pathways, transit, and micro-mobility. Future-oriented solutions envision advanced transit systems like enhanced bus services(express routes,dedicated lanes), autonomous shuttles, personal rapid transit, streetcars, or light rail in collaboration with the City of San Marcos. The plan also includes shared bikes paths and tracks. There’s also interest in making alternative modes more inviting, accessible, and safe to reduce car dependency.

Connectivity Projects: A proposed pedestrian bridge connecting the university core pedestrian corridor to the STEM quad area is discussed to provide connection. This project would require City of San Marcos review and permitting.

High Density Transportation: The high density at Texas State increases the potential for transport infrastructure and services supporting multi-modal travel. A compact campus design can promote high trip rates among students. High student density present challenges but also opportunities for promoting alternative transportation. Analyzing the travel behavior using parking survey data is an ongoing research effort to leverage campus characteristics and existing multi-modal systems.

In summary TXST and San Marcos offer a compelling location for research, situated within a rapidly growing economic hub and benefiting from the university’s race to R1 and its network of specialized satellite locations. The San Marcos campus itself is a characterized by its size, unique topography, and integration with significant natural features like the San Marcos River. The local transportation environment includes a pedestrian-centric core, existing parking infrastructure, and congested roadways challenges. The future vision includes enhancing physical connectivity through transit, micro-mobility, and pedestrian infrastructure improvements, addressing the challenges and capitalizing on the opportunities presented by the compact, high density campus environment. This research focuses on understanding how to further leverage physical features of campus to reduce transportation emissions.

### 1.2 Data Collection:

The primary source for this research is Texas State University’s Parking survey from Fall 2024 and 2025-2035 Camps Master Plan.

The 2024 parking survey will be utilized to investigated TXST students travel behavior. This parking survey was administrator via university emails to all TXST students, gathering comprehensive information regarding daily commuting patterns. This survey received a response rate of 2.9%(0.02908), The data collected from the student responses is a quantitative in nature and will be used for a statistical summary analysis of travel behavior.

* Analysis:
  + Perform statistical summary analysis of travel behavior based on survey responses.
  + Identify key insights related to transportation patterns.
    - Primary travel mode
    - Frequency of travel
    - Trip distance and length
    - Parking permit ownership
    - Private vehicle access
  + Examine the potential impact of changes in travel behavior on greenhouse gas emissions.
* Summary and Recommendations:
  + Draft a summary analysis of the findings.
  + Propose actionable steps for TXST to promote sustainable transportation.

#### 1.2.1 Objectives

* Analyze transportation and travel behavior of Texas State University students using parking survey data from the Fall 2024 semester.
* Identify trends and areas for improvement in campus transportation planning using 2025-2035 Campus Master Plans.
* Provide actionable recommendations to reduce transportation-related greenhouse gas emissions.

### 1.3 Expected Outcomes

* Enhanced understanding of TXST students’ travel behavior and its environmental impact.
* Identification of key factors and trends influencing transportation choices among students.
* Actionable recommendations for TXST to reduce transportation-related GHGe and promote sustainable travel options.

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