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Mobility Enhancements on a Multi-Nodal Urban Campus

JUNE 2013

FTA Report No. 0041
Federal Transit Administration

PREPARED BY

Alliance for Transportation Research Institute (ATRI)
University of New Mexico

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SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC

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ABSTRACT

This report documents a comprehensive needs analysis of the transportation options at the University of New Mexico (UNM), including an examination of administrative and operational alternatives to improve both the internal shuttle service provided by the University as well as transit service provided by the City of Albuquerque to university-area locations. The study also examines transit options for providing service from campus locations to connections for the NM Rail Runner Express commuter rail operation.

The project plan for addressing these issues consisted of a literature search on sustainability issues related to transportation on campuses nationwide; an on-line survey and evaluation of existing multi-nodal campus planning models; and data collection and analysis of the existing campus travel issues at UNM as identified both from existing documents and additional acquired data. This information was used to develop both short-term operational improvement options for the UNM campus and concept-level recommendations to address longer term issues.

The most important issue for the continuation of a successful shuttle service at UNM is a stable, long-term funding source. For example, the current model for funding new buses on a 12-year replacement schedule is unstable. Stable revenue sources can be achieved only through the assistance of student fees. Parking revenues will decrease as parking spaces disappear because of development and other funding sources, such as State aid, are uncertain. If the implementation of a student "transportation" fee is to be successful, however, it must have the support of the student body and its leadership. An effort to elicit support from students early in the implementation and a feeling among students that the use of alternative transportation is a "green" approach to congestion and air quality issues at UNM will facilitate the process.

EXECUTIVE SUMMARY

Background

Nearly 74,000 trips per day are made by students, faculty, staff, visitors, and patients to and from the University of Mexico's (UNM) three campuses and the nearby Central New Mexico Community College (CNM). The area is Albuquerque's largest activity center and traffic generator and UNM's campuses include academic centers, a hospital complex, athletic venues, and a science and technology park.

Two separate UNM transit operations provide no-cost shuttle services for university students, faculty, and staff. UNM's Parking and Transportation Services (PATS) operates shuttles internal to the Main Campus and to remote parking areas on the North and South campuses. The UNM Hospital (UNMH) shuttle services hospital staff, visitors, and patients from remote parking lots to the Hospital or other nearby UNMH medical service locations. The two UNM shuttle operations are separate and unique systems, including their administrative, planning, and operating environments. CNM provides some free parking for its students but does not operate any shuttles of its own.

In addition to UNM shuttle services, ABQ Ride, Albuquerque's bus transit system, operates 10 routes, including peak-period and express-route operations. Since 2007, the University has participated in the ABQ Ride transit program, which provides free access to students, faculty, and staff not only to and from campus, but system-wide. However, there is little coordination between ABQ Ride and the University-provided shuttles.

UNM's 2011 Consolidated Master Plan identified goals and objectives relating to sustainability and transportation. These included reducing the campus's carbon footprint by 50 percent by the year 2020 by increasing access to transit on all campuses, decreasing automobile dependency in and around campus by integrating the City and University transit systems, improving links between the University's North, South, and Main campuses, and making the Main Campus motorist-free.

Objectives

The purpose of this study was to identify successful Travel Demand Management (TDM) strategies and programs at multi-nodal urban universities that could be implemented at UNM to improve transit operations and increase alternative mode utilization. The project also examined mobility enhancements (primarily transit) and alternatives for multi-modal utilization and multi-nodal coordination of both internal transit service at UNM and CNM and those provided by Albuquerque's ABQ Ride system.

Findings

A wide range of transportation options was identified in the seven multi-nodal campus case studies. However, it was difficult to assess strategies and their impact

on programs and operations because much depends on the institutional commitment to sustainability efforts, the campus setting, the campus location, student density, and the level of institutional financial support for transportation programs.

Connectivity among campuses is a common issue among multi-nodal campuses. Significant challenges emerge for campus transportation planners to not only provide their own services across extended areas but also to coordinate their services with other metropolitan or regional transportation operators. The literature review yielded little information on the interaction of various modes such as walking, bicycling, using transit, and using auto, particularly for those campuses characterized as having more than one geographic location.

TDM strategies that influence the transportation behavior of students, employees, and visitors to campus locations include controlling the supply and price of parking, financial (dis)incentives to drive alone or travel using other modes, the level of transit service available, and the ease of bicycle use. These approaches may have positive impacts on traveler mode choice, time of day traveled, frequency, and route of travel. Coupled with a university's unique attributes, especially in terms of trip density to a limited number of destinations, this should lead to the successful application of various TDM measures.

Multi-Nodal Campus Case Studies

In the seven multi-nodal case studies, the most common characteristic was the operation of inter-campus transit services to individual campuses. The success of these university transit operations is dependent upon the vitality of its alternative transportation programs. Often, multi-nodal universities have hospitals, medical schools, and/or research centers that are separate from the main academic campus. These centers have different transportation needs than traditional main campus activities. Headways and types of transit services depend mostly on the distance between campuses and student density. Key findings identified in the case studies include:

- Sustainability goals often are used as the overarching concept for transportation services, including parking and alternative transportation modes: bicycling, walking, carpools/vanpools, and car-sharing. However, only a few universities prominently display transportation-related policies, reports, and data on their websites.
- Successful transit programs include free transit passes to students and employees, allowing free/subsidized access to bus and rail transit; high-frequency and late-night transit; transit amenities at bus stops; and guaranteed emergency rides home for those who participate in transit pass or carpool programs (most universities studied).

- Social media and mobile device applications are important marketing and communication tools for university transportation programs.
- Compressed work weeks and telecommuting should be encouraged.
- Carpools and vanpools should be provided for access to shared vehicles for some trips through non-profit or commercial "carshare" programs or on-campus car rentals.
- Alternative transportation modes should be marketed in new student orientation programs.
- Infrastructure should be improved and programs added to encourage walking and bicycling should be promoted.
- Increased parking rates have reduced demand (Arizona State University, University of California at Davis).
- Coordination with public agencies and neighborhoods is important for developing integrated transportation systems (Duke, University of California at Davis).

The case studies also identified several innovations in university transportation programs, including:

- Maintaining a motorist-free campus core (University of Texas at Austin, Duke, University of California at Davis).
- Prohibiting first- or second -year students from bringing cars to campus (Duke).
- Using Web-based, user-friendly dashboards to provide metrics for sustainability programs on transportation, graphic representation of multi-year modal share data, and other related performance measures (University of Washington).
- Using transportation- and sustainability-focused branding to market and promote alternative transportation programs (University of Texas at Austin, University of Washington, University of California at Davis).
- Integrating sustainable transportation goals into the design of transportation portals (University of Washington, University of Texas at Austin, Arizona State University).

UNM Case Study Findings

In spite of an increasing student population, UNM has been successful in using TDM strategies, resulting in a reduction of single occupancy vehicles (SOV) usage from 78 percent in 2004 to 49 percent in 2010. This significant decrease is attributed to the implementation of the free ABQ Ride transit program in 2007. UNM is continuing its transition from a commuter university to a sustainable, urban, residential university by increasing on- and near-campus housing by decreasing surface parking and implementing TDM measures. Key findings from the UNM case study include the following:

- In 2011, UNM Regents adopted a Consolidated Master Plan for the three campuses that focuses on multi-nodal and multi-modal transportation connectivity issues; addresses parking in a comprehensive manner; improves pedestrian crossings at major intersections; increases transit, pedestrian, and carpool/vanpool use; and restricts auto access to the Main Campus.
- UNM's financing model for its transportation services needs to be re-assessed. Current UNM transportation services are funded solely through parking permits and parking enforcement fines. The ongoing decrease in surface parking will constrain permit revenue and special event parking fees. Limited funding restricts UNM's ability to purchase new vehicles for its shuttle services and to enhance alternative transportation programs.
- The free Lobo Shuttle transports students around the Main Campus and to/from remote parking areas located both north and south of the Main Campus. This shuttle service had more than 1.8 million riders in 2010. The UNMH or North Campus shuttle serves only the medical complex. However, the Main Campus's PATS Department conducts parking regulation enforcement responsibilities and issues parking permits for the North Campus. The North and Main campus shuttle systems have separate administration, planning, and operating environments.
- In 2010, ABQ Ride, the City transit provider, served 11.7 million riders, a 39 percent increase from 2009. Approximately 14,000 UNM free transit passes were issued, resulting in in about 15 percent or 1.8 million ABQ Ride passengers.
- Modal split comparisons show that 51 percent of UNM students use alternative modes compared to 46–87 percent at case study universities. In regards to UNM employees, 41 percent use alternative transportation modes compared to 22–59 percent at peer institutions. On the other hand, UNM, at 11 percent, had the lowest percentage of on-campus housing; other multi-nodal universities ranged from 15–39 percent.
- The Mid-Region Council of Governments (MRCOG) is the lead agency in several initiatives concerning transportation issues internal to UNM and the surrounding areas. These include a TDM study exploring transportation needs and opportunities for UNM and CNM; applying for a multi-modal transit center located on the North Campus; and conducting a Federal Transit Administration-funded study for an alternatives analysis study for the heavily-traveled north-south corridor from the UNM/CNM area to the Albuquerque airport. These initiatives include participants from local, city, and state agencies.
- UNM lacks an internal transportation coordination committee as well as formal participation in regional MRCOG transportation committees.

Recommendations

While some of these recommendations have been documented in previous UNM studies and reports, the lack of implementation necessitates that they be restated and reemphasized because of their importance. The conclusions and recommendations are grouped both according to time frame (short-term vs. long term) and whether each is policy- or operations-related.

Short-Term Policy Recommendations

- Continue UNM's participation in the ABQ Ride free transit pass program.
  - Greater UNM involvement is needed both internally through the creation of a Transportation Coordination Committee and externally with the broader transportation community through regional MRCOG committees, ABQ Ride, the Rio Metro Regional Transit District, and the New Mexico Department of Transportation (NMDOT).
- Create a new staff position within UNM's PATS to perform planning or operational responsibilities, including enhancing alternative transportation programs.
- Participate in the American Public Transportation Association's (APTA) Small Operations Committee, including the biennial Transportation and University Communities Conference, the only national conference addressing the unique transportation needs experienced within university communities.
- Develop branding for UNM transportation programs, including linking the University's sustainability goals to UNM's transportation portals that reflect those priorities.
- Create linkages between the UNM PATS website and University transportation-related reports and resources. Develop user-friendly dashboards for displaying results from the annual commuter survey and other performance measures.
- Use targeted marketing and outreach activities to grow transit ridership to/on campus. Partner/collaborate with student government leaders and student newspapers. Integrate social media for transmitting and monitoring comments via Hootsuite (www.hootsuite.com) about UNM transportation services.
- Continue to develop mobile device applications to enhance transportation services. Current applications include the Parkmobile and "Where's My Bus?"
- Revise the UNM Commuter Survey to include attitudinal questions relating to the campus shuttle service, the ABQ Ride Free Bus Pass program, and campus transportation issues in general. Administer the survey to all faculty, staff, and students. In addition to modal choice data, use the survey to assess the number students who work off campus.

- On the South Campus, create better coordination of special event parking and remote parking among the UNM Athletics Department, the Science and Technology Park, the City of Albuquerque, and CNM.

Short-Term Operational Recommendations

- Reduce drive times for the South Lot shuttle by modifying the route to avoid buses entering the parking lots. New transit buses with low floors and wide doors would allow quicker loading and unloading and further reduce dwell times.
- Use automated gates at the Terrace Avenue exit to limit Main Campus access to only UNM shuttles.
- Relocate bus stops to remove underused stops such as the ABQ Ride Route 50. This action would conform to the University's long-range goal of making portions of Redondo Drive "limited to pedestrians, bicyclists, shuttles, and maintenance vehicles." The removal of City buses from Redondo would also eliminate congestion due to buses waiting for a traffic signal to change at MLK between Redondo and University.
- Because of limited ridership, examine the benefit/cost of UNM's Main Campus and UNMH's fixed-route shuttle between those locations and the Alvarado Transportation Center's morning and afternoon New Mexico Rail Runner regional rail connections.
- Because the shuttle service from the "T" parking lot averages only a little over 500 riders per day and is only about 1,500 feet walking distance from its most remote destination, the permit price could be raised to more fully cover costs or the service could be curtailed due to its relative walking proximity to many campus locations.

Long-Term Policy Recommendations

- Examine transportation funding models from other universities to determine a path forward in addressing current revenue generation limitations. The current funding model for the UNM PATS, which relies on revenue from only permit fees, parking fines, and special event parking, is unsustainable. As more surface parking area is consumed by other higher-priority uses, fee revenue will decrease. Absent any dramatic increase in parking rates, other additional revenues, such as student fees, should be considered.
- Implement UNM's 2011 Consolidated Master Plan, in particular, its connectivity goals among campuses, through a merged, unified transportation system and a robust alternative transportation system.
- As UNM increases its on-campus student housing and surface parking decreases, parking strategies could include giving housing priority for students choosing to live car-free in new residence halls and providing convenient, covered bicycle parking available only to residents. Since a car-free campus is

the goal, all residence hall parking could be moved from current locations to remote lots served by University shuttles or other transit service and issued special discounted permits.

- Consider recommendations to reduce peak student loadings throughout the day, either through adjustment of class schedules (including Saturday classes), offering more on-line or other remote classes, or through congestion pricing—charging more for parking during periods of heavy loads.
- UNM has explored bike-sharing for on-campus and short off-campus trips. University settings, with their relatively small areas, short trip lengths, and student populations accustomed to traveling by bicycle, are ideal locations for bike-share programs. Although preliminary UNM estimates have not been cost effective, this opportunity should be explored further to augment current alternative transportation programs.
- Evaluate UNM's Zipcar program and compare it with recent personal car-sharing networks, where individuals enroll their own vehicle to be rented by others on a short-term basis. This could result in a car-sharing program without the financing and fleet maintenance costs.
- Prepare a cost analysis for using part-time student bus drivers. Other universities have realized cost savings due to lower wages and benefits.
- Support regional efforts to create a multi-modal center to serve as the connection point for the City's Rapid Ride Network and the UNM shuttle system to be located on the UNM Campus at Lomas Boulevard and I-25. The center would provide parking and be a major distribution point for visitors, faculty, students, staff, and patients to access the campus shuttle systems, walking and biking paths, and other future transportation systems.
- In line with outsourcing efforts in other areas of university life (food services, custodial services), some universities are considering selling or leasing their parking operations to a private operator. Ohio State University, for example, is reported to be considering a 50-year lease of its parking facilities for $375 million.

Conclusions

Like other multi-nodal universities in the case studies, transportation initiatives at UNM tend to focus on similar topics. Institutionally, recommendations from previous UNM campus master plans, studies, and reports have strongly supported connectivity goals, including a merged, unified, and consolidated transit system coupled with reduced SOV usage and a motorist-free Main Campus. Other recommendations about external connectivity issues should emanate from FTA-supported initiatives now underway.

Operationally, the most important transportation issue at UNM is developing a stable, long-term funding source for its transportation services. Consideration

should be given to a student "transportation" fee. To be successful, it would need the support of the student body and its leadership. Efforts to elicit support from students should include use of alternative transportation as a "green" approach to congestion and air quality issues.

SECTION 1

Introduction

The University of New Mexico (UNM) campus, with more than 28,000 students, 2,800 faculty, and 5,000 staff, is one of the largest travel destinations in the Albuquerque, New Mexico, metropolitan region, with thousands of daily trips arriving by automobile, transit, bicycle, and walking. Transportation to, from, and within the UNM campus(es) has a significant impact, not only locally but on the surrounding communities as well. When considered as a Livable Communities initiative, campus mobility improvements can result in improved quality of life for the entire campus community and create a more efficient and accessible transportation network, not only on campus but in metropolitan Albuquerque as well.

More than one-half of the total acreage on the University's North, South, and Central Campus areas is devoted to surface parking, much of it at locations remote from the ultimate destinations of campus travelers. As a result, no-cost shuttle services are provided by the University serving not only faculty, staff, and students on the Main (Central) Campus, but also for staff and patients of the University of New Mexico Hospital (UNMH) complex on the North Campus and the athletic facilities and remote parking lot locations in the South Campus areas. The various shuttle operations are, unfortunately, separate and unique systems, with individual administrative, planning, and operating environments.

In addition to transit services provided by the University, the City of Albuquerque's transit system, ABQ Ride, operates 10 routes that serve the UNM campus areas. These routes include not only local service but also peak-period and express-route operations. Since 2008, the University, with additional monies appropriated by the New Mexico state legislature, has provided funding to the City to allow UNM faculty, staff, and students to ride free on ABQ Ride, not only to and from campus but system-wide. Much like the individual UNM shuttle services, however, there is little coordination between ABQ Ride and the University-provided shuttles.

The UNM 2009 Campus Master Plan Update [1] identified several goals and objectives relating to transportation. These include reducing the campus's carbon footprint by 50 percent by the year 2020 through increasing access to transit on all campuses, decreasing automobile dependency in and around campus by integrating the City and University transit systems, and improving links between the University's North, South, and Central campuses. The Master Plan also suggests that future transit service between Central campus locations and a proposed satellite campus in the City of Rio Rancho on the west side of the metropolitan area need to be investigated.

The above discussion, based on a UNM Transportation Strategic Plan prepared for the University Planning and Campus Development Department by a local consultant [2], indicates the desirability of a comprehensive needs analysis of the transportation options at UNM. This study examines administrative and operational alternatives to improve coordination of both internal transit service at UNM and between UNM services and those provided by the City of Albuquerque. The study also identifies transit options for providing service to the new West Side Campus and shuttle services between campus locations and stations of the NM Rail Runner Express commuter rail operation.

The project plan for addressing the issues identified above was accomplished through fve objectives: a survey and evaluation of existing campus planning models, including a literature search and a survey of selected campuses; data collection and travel surveys of the existing campus population at UNM; the development of short-term improvement options for the UNM campus(es); future travel demand projections; and concept-level recommendations to address longer term issues.

The remaining sections of this document describe the UNM campus background in Section 2, including historical transportation issues, the current organizational structure for transportation responsibilities on campus, and recent policy issues in transitioning to a more sustainable urban campus environment. Section 3 is a review of state-of-the-art literature on sustainability and transportation on university campuses nationwide. Section 4 presents a series of sustainability and transportation state-of-the-practice case studies from several peer institutions summarized from publically-available websites of the various universities. Section 5 examines, in detail, the existing transportation systems in the UNM area, including parking, transit ridership, and other operational data as well as pedestrian and bike uses on the campuses. Section 6 discusses several intelligent transportation system applications to enhance the UNM campus transportation environment, and Section 7 details both short- and long-term findings, conclusions, and recommendations.

SECTION 2

UNM/CNM Campus Background and Overview

UNM and Central New Mexico Community College (CNM) are two of New Mexico's leading secondary education institutions. Both are located near downtown Albuquerque, which has a metropolitan population of 907,755 that is expected to grow to 1.5 million by 2035. These two institutions enrolled approximately 45,000 students in 2010. Adjacent to UNM's Central Campus is the University of New Mexico Hospital (UNMH) and Health Sciences Center (HSC). Approximately 74,000 trips are made per day to and from these institutions, making them the city's largest activity center and traffic generator [3].

UNM's student population of 28,757, including 20,479 full-time and 8,278 part-time students, is anticipated to increase by 6,000 in the next five years. With an average time to graduation of 6.5 years, students commute to campus for a longer period of time, and the large percentage of non-traditional students (married, working, part-time) has an additional impact on the number of daily trips made to the campus.

The multi-nodal nature of the UNM area, with North, Central and South campus nodes located approximately one mile apart and with the CNM campus co-located between the Central and South nodes of UNM, adds to trip-making in the area. The main campuses are land-locked, limiting further expansion and resulting in the construction of a newly-opened satellite campus 18 miles (29.0 km) to the west in the city of Rio Rancho [4].

UNM's multi-nodal campuses have distinct characteristics that impact travel in the area:

- North Campus houses the Medical School and Hospital as well as the Law School. A new 800-bed hospital is to be built on land west of its current facilities. The North Campus has its own shuttle system, primarily for use by medical staff and hospital visitors; the system has its own administration and operational structure.
- Main Campus houses the academic activities of the University and has a pedestrian core with peripheral parking in both close-in and remote lots. It is intended that the Main Campus will eventually be car-free.
- South Campus is the location of the University's Science and Technology Park, the athletic complex, family housing, new residence halls, large-scale parking lots for athletic events, and remote lots for Main Campus visitors.

Planning efforts are underway for more commercial cluster development in this area.

- The Rio Rancho Campus is a new campus that opened in 2010, 18 miles (29.0 km) west of the main campus. There is currently no University or City of Albuquerque transit service from the Main Campus to the Rio Rancho Campus.

Central New Mexico Community College Profile

CNM, a commuter two-year college, has seven campuses in Albuquerque and Rio Rancho. The Main Campus, located between UNM's Main and South campuses, is the largest, with 16,000 of the institution's 28,000 students in attendance there. CNM provides free parking for its students and does not operate any shuttles of its own, and there is no way to identify CNM students who may use UNM shuttles to travel between campuses. CNM has course articulation agreements with UNM, and nearly 3,000 students are enrolled at both CNM and UNM, taking classes at multiple locations.

UNM Campus Shuttles

Most destinations to UNM are on the Main Campus. The free Lobo Shuttle transports students around the Main Campus and to/from the remote parking areas, which are located north and south of the Main Campus. The North Campus shuttle serves only the medical complex, and the North and Main campus shuttle systems have separate administration, planning, and operating environments. However, the Main Campus's Parking and Transportation Services (PATS) department is responsible for parking regulation enforcement and issues parking permits for the North Campus.

Transitioning to a Residential Campus

In September 2011, UNM's Board of Regents adopted its Consolidated Master Plan, which includes a merged, unified transportation system among its three urban campuses [5]. The plan proposes a unified system that will make the UNM campuses more livable and sustainable by promoting alternative transportation systems through Transportation Demand Management (TDM) strategies. UNM has been successful in using selected TDM strategies, which have reduced single occupancy vehicle (SOV) usage for trips to UNM from 78 percent in 2004 to 49 percent in 2010. However, there is growing pressure to further reduce SOV usage in coming years, as more and more surface parking will be consumed by additional campus facilities and increased on-campus

housing as UNM continues to take steps to transition from a commuter university to a residential one. A robust alternative transportation system, therefore, is essential for further reducing SOV use and meeting UNM's climate change goal to be carbon-neutral by 2030.

UNM's transition from a commuter to a residential campus will also require the University to implement additional TDM strategies. Currently, only 2,700 (about 11%) of UNM students live in residence halls on campus. As new on-campus dorms are constructed, there will be an initial negative impact on the parking supply; over the longer term, however, demand for non-residential parking on campus should be reduced. Last year, for example, Lobo Village, which houses 864 students and faculty, was opened at a location two miles (3.2 km) from the Main Campus in an area serviced by Lobo shuttles to the Main Campus.

According to the Lobo Development Corporation Strategic Parking Proposal Study [6], the first phase of new dormitory construction, begun in 2011 on the Main Campus, will result in 500 to 1,000 additional beds and, over the longer term, will add 4,000 new beds. Since about two-thirds of dormitory residents currently purchase parking permits and new dorms are being built in existing parking areas, the study estimates that there will be shortage of 2,290 parking spaces on the Main Campus. Additional TDM strategies are being contemplated to further reduce SOV usage and promote alternative transportation strategies.

UNM Documents that Impact Transportation

Over the last seven years, UNM has completed or participated in a multitude of plans and studies that address not only transportation but also housing, athletics, and general campus planning, including the following:

- Campus Parking: A Study of a Remote Parking Shuttle (2005)
- UNM Housing Study (2005)
- UNM Parking Master Plan (2005)
- UNM Campus Bicycle Master Plan (Draft, April 2009)
- UNM Transportation Strategic Plan (2009)
- UNM Climate Action Plan (2009)
- UNM West Master Plan (2009)
- UNM Master Plan Update (2009)
- UNM Health Science Center Master Plan (2010)

- UNM Commuter Survey (2010)
- UNM South Campus Placemaking Plan (June 2010)
- UNM Health Sciences Center Master Plan (July 2010)
- UNM/CNM Travel Demand Management Study (July 2010)
- 2010 Transportation Survey: 2035 Metropolitan Plan (Mid-Region Council of Governments, MRCOG)
- Lobo Development Corporation Strategic Parking Proposal (2010)
- Travel Demand Management Study: Phase I Findings—Travel Characteristics and Opportunities (2011)
- UNM Consolidated Master Plan (September 2011)

Many of these documents are referenced in subsequent sections of this report.

One of the primary tasks of this project was to review and analyze UNM-related transportation activities as detailed in many of the above plans and studies as well as to identify and analyze additional transportation data specific to the UNM area. Data produced by the Travel Demand Management Study [3], for example, and other reports is analyzed in subsequent sections to determine what additional information is needed. Source data regarding students, staff, and faculty are also available, as are travel projections through 2015. UNM's PATS also provided data about Lobo Shuttle peak times as well as ridership details by shuttle routes and ridership by time of day. In addition, data from UNM hospital shuttles were obtained and are analyzed.

Several of the more significant plans listed above that are related to transportation, particularly those that have been formally adopted by the University's Board of Regents, are discussed below; other additional studies and surveys above are discussed in subsequent sections of the report.

UNM Consolidated Master Plan

The Consolidated Master Plan for the North, Central (Main), and South campuses was approved by the University's Board of Regents on September 13, 2011. It represents a shared vision, physical framework, and land use plan that will guide future UNM development and proposes specific measures designed to connect the north, central and south portions of UNM into one cohesive campus. The Plan specifies overall transportation goals for its three campuses, focusing on connectivity issues, reducing SOV parking, and making transit the primary means of accessing the university. Specific transportation goals for each campus are shown in Figure 2-1 [5].

Figure 2-1

UNM Consolidated Master Plan Transportation Goals

Source: Reference 5, p. 88

North Campus

- Provide quick and efficient transportation between medical buildings. Existing and proposed facilities are spread out over a large area.
- Improve Access: Align roads into a grid system that will improve connectivity, address parking in a comprehensive fashion, and increase shuttle service between campuses.

Central Campus

- Improve pedestrian crossings on all major streets: University Blvd, Central Ave, Lomas Blvd.
- Increase enrollment without increasing parking.
- Increase pedestrian and bicycle commuting.
- Increase transit utilization.
- Increase car and van pools.
- Improve links between North, Central, and South campus.
- Restrict auto access to Central Campus.

South Campus

- Improve parking coordination.
- Reduce speed on Cesar Chavez and University Blvds.
- Improve links to Central Campus.
- Alternative Transportation at UNM.
- Zipcar, a national car-sharing service that allows members to reserve and rent cars on an as-needed basis. UNM currently has five vehicle places around campus for students, staff, faculty, and community members.
- Lobo Bike Program, a bike-sharing program that loans bikes randomly to selected University departments.
- Vanpools, organized carpooling from distant areas of the region.
- Q Bike program, a bike-sharing program in which bikes can be checked out and returned at kiosks located around city and campus.

UNM Transportation Strategic Plan

Strategies identified in the 2009 UNM Transportation Strategic Plan [2] are aimed at reducing the number of vehicle trips to and from the campus. These strategies are a reflection of the University's long-term goals of decreased auto dependency, carbon-neutrality, and the production of no additional greenhouse gases (GHGs). Specific goals of the long-term plan involve integrating sustainability into all aspects of campus life, increasing the ability of the North Campus Health Sciences Center (HSC) to better serve the surrounding community, decreasing dependency on automobiles both in and around the campuses, and prioritizing pedestrian access and connectivity.

Specific objectives identified in the Plan are further broken down for each of the three campus "nodes":

- North Campus
  - Quick and efficient transportation between multiple medical buildings spread out over a large area.
  - Improved road access with multiple access points to improve circulation for staff, patients, and delivery and service vehicles.
  - More parking spaces for both existing and new buildings. New buildings built on existing parking lots will require parking structures.
  - Improved shuttle services for staff parking in remote lots, as well as for patients arriving for appointments and visitors to the hospital.

- Central (Main) Campus
  - Better management of parking availability and promotion of alternative transportation modes to reduce automobile impact on campus.
  - Provision of more desirable on-campus housing to increase student enrollment without increasing parking supply.
  - Increased commuting to/from campus by transit, bicycle, and walking as well as by car and van pooling.
  - Improved linkages between all three campuses for pedestrians, bicycles, and transit.
  - Improved alternative transportation communications through better signage and other data dissemination methods, including social media.

- South Campus
  - Better coordination among the UNM Athletics Department, the Science and Technology Park, the City of Albuquerque, and CNM for

both special event parking as well as remote parking serving the Main Campus.

– Improved coordination/connections with city and regional transit entities.

Recommendations made in the Plan in support of the University's goals include the following:

- Formation of a University-wide Transportation Coordinating Committee to coordinate transportation issues across all three campuses.
- University participation in the activities of external transportation entities (such as MRCOG) to ensure involvement in decisions affecting the University.
- Coordination of internal transit operations to better achieve administrative and operational efficiencies.
- Examination of alternative funding mechanisms for operation of the University's shuttles to decrease dependence on parking fees.

Solutions to address the identified deficiencies of the UNM transportation system are described in a final section of the Plan. They include both policy issues such as the continuation of a free bus pass program and increasing commercial services and amenities on or near campus as well as specific operational improvements such as improved bicycle facilities and the construction of a multi-modal transportation center at a campus location.

This final section of the Plan suggests areas for further study, such as analyzing address data to improve transit service and a transportation study of the existing roadway network to determine the impact of growth issues and subsequent traffic impacts.

UNM Parking Master Plan

This comprehensive study of the University's parking system (the Walker Study) recommended the following [7]:

- Consolidation of all transportation services (Main, North, and South campuses) under one administrative agency.
- Development of alternatives to reduce single occupancy vehicle trips, both within and to/from the campuses.
- Construction of additional parking on both the North and Main campuses.
- Increased revenue sources devoted solely to parking and transportation improvements. These would include not only permit fees, short-term parking revenue, and citation fines but also a universal student facilities fee.

Land Use and Transportation

With increasing traffic due to growth both in the city and enrollment at the two institutions, the MRCOG traffic model in the Travel Demand Study [3] shows streets in the area to be approaching, or over, capacity by 2015. Principal access points to UNM and CNM are from interstate highways I-25 on the west and I-40 to the north; the principal arterials of Lomas Boulevard, Central Avenue, and University Boulevard provide additional access to campus from the north, south, and west, respectively.

The MRCOG study describes the UNM/CNM area as a unique section of the city because of both the number of trips generated and their central location near the Airport International Airport, Downtown Albuquerque, and the Nob Hill shopping area. The area includes a wide range of land uses, including differing housing options and pricing, both pedestrian and auto-oriented retail, various commercial activities, and a number of recreational and entertainment uses. The recently-opened Lobo Village houses 864 students and faculty on the South Campus and is envisioned as the start of significant mixed use development in that area.

As a result, these environments have meant both valuable land use and multiple transportation opportunities. Unfortunately, they have also caused tension between the institutions, the surrounding neighborhoods, and the City due to traffic issues. A recently-proposed parking structure on the western edge of the Main Campus was terminated due to neighborhood opposition.

SECTION 3

Literature Review: University Transportation and Sustainability

Introduction

Maintaining university quality of life and environmental values while providing access to and from campus is challenging. Universities are distinct communities with unique transportation needs. The transportation system within and around a university campus is a critical mobility component for thousands of students, faculty, and staff arriving and departing on a daily basis. Over the next decade, universities are expected to substantially increase enrollment, resulting in increased congestion and parking problems [8]. Universities are in an excellent position to experiment with and implement transportation policy changes. Through institutional policies and planning decisions, universities have control over their road network, parking facilities, and land uses. Sustainability policies can enhance not only the university's transportation system, but also the surrounding community [9, 10].

Campus transportation strategic plans often are a major ingredient in university master plans that promote sustainability objectives. University policies relating to transportation incentives can be implemented that reduce SOV use on campus and the use of green technologies through alternative fuels in university-owned vehicles. Travel demand management strategies are also commonly used to stimulate non-automobile commuting and promote a more efficient use of transportation resources [11].

Sustainability and Transportation

Any university transition to sustainability must confront the issues surrounding transportation. Growing interest in livability and sustainable development serves to optimize university quality of life and address its environmental quality, social equity, economic vitality, and climate change issues [12]. Universities generally have complex, multimodal transportation systems that incorporate SOVs, transit, bicycles, and pedestrians into one transportation system. Transportation challenges for their unique transportation requirements include population mix and density, irregular class schedules, seasonality of campus operations, continuous travel movements throughout the day, and a high concentration of trips during multiple peak periods (morning, lunch, afternoon). In contrast, urban areas generate peak traffic times during rush times, which require different approaches to transportation issues. Coordinating campus mobility needs with the local community and

integrating with the local and regional transportation system are critical to addressing the university's mobility and accessibility goals [9, 13, 14].

As the student population grows, demand for parking increases as well. Balancing parking demand with supply is no longer a sustainable practice because of the lack of land for new parking lots, the high costs of building parking structures, and pressure from surrounding communities due to overflow parking in their neighborhoods. The desire to preserve air quality and campus green spaces is leading many institutions towards sustainable transportation strategies based on improved and expanded transit access, better bicycle and pedestrian facilities, and financial incentives to drive less [10, 15, 16]. Campus transportation planning provides sustainability incentives for walking and bicycling, taking mass transit, ridesharing, and discouraging the use of SOVs by passing on the full costs of parking to drivers. Linking transportation planning to land-use planning is crucial for planning integrated systems [13].

Universities also host large athletic events and special entertainment events that draw participants from the community often in the evening or on weekends. This transportation need differs from traffic that is generated by the on-campus educational activities that are mostly conducted during the day.

Sustainability and Community Livability

Transportation decisions have a major impact on community livability. In the past, transportation planning was centered on mobility or the physical movement of vehicles. With sustainability, accessibility becomes the focus so that land-use factors and mobility substitutes, such as telecommunications, are integrated in the planning process. This accessibility-based focus expands the range of solutions that can be applied to transportation problems [17].

Accessibility can be measured by the number of travel opportunities or destinations within a particular travel area, plus either travel time or travel distance. On the other hand, mobility is measured by the ability to move efficiently between origins and destinations. As a result, mobility is directly influenced by the layout of the transportation system [17].

The U.S. Department of Transportation (USDOT), like other federal agencies, has adopted goals as a part of its Livability Initiative that:

- Encourage linked transportation and land-use planning.
- Allow communities to choose among transportation alternatives.

- Promote consideration of actions that make better use of the existing system (carpools, vanpools, walking, bicycling).
- Reduce greenhouse gas emissions through transportation strategies [18].

The Federal Transit Administration's (FTA) Livability Communities initiative is intended to help communities grow in a way that ensures a high quality of life and sustainable economic growth. Transit is essential for the component through land use planning, pedestrian access, and urban design that fosters the use of alternative transportation modes. . The link between transit and communities is strengthened by improved personal mobility, transportation system performance, and enhanced quality of life in communities [19].

Mobility enhancements can be achieved through TDM strategies, land use planning, and technologies such as intelligent transportation systems (ITS). Campus livability can be enhanced by creating opportunities for bicyclists and pedestrians. A TDM strategy for reducing SOV traffic is dependent upon the adequacy of other campus travel modes. Campus transportation policies and land-use planning are important components of university sustainability goals.

Sustainability Indicators

There is information in the literature as well as existing policies that can help form the basis for a set of indicators for quantifying the elements of transportation sustainability [12, 20, 21]. Litman, in fact, prepared an extensive guidance document for developing indicators for sustainable and livable transportation planning. These indicators can be used for identifying trends, predicting problems, setting targets, evaluating solutions, and measuring progress [20].

Table 3-1 summarizes performance measures use by states to evaluate the quality of transportation and land-use planning coordination based on Litman's literature review and a survey of 25 states. According to Litman, these are consistent with many sustainable transportation planning indicators [20].

Table 3-2 details nine sustainability indicators relating to transportation: travel activity, air pollution emissions, noise pollution, traffic risk, economic productivity, overall accessibility, land use impacts, equity, and transport policy and planning. Each category is rated "A" (applicable to all situations and jurisdictions) or "B" (applicable if relevant or feasible) [17].

Table 3-1

State DOT Land Use Performance Indicators

Goal	Performance Measures
Increased transportation options	Percentage of commuters driving alone to work
	Number of spaces used at park and ride facilities
	Vehicle miles traveled per capita
	Travel time and distance to work
Increased transportation options	Ability to get from one destination to another readily, where destinations include jobs, retail and tourist stops, and transit services
	Percentage of housing units built by location type (e.g., rural growth center, developing area, remaining rural area, or developed area)
	Percentage of jobs/population within particular distance of transit or other modes
	Miles of bike/pedestrian facilities constructed
	Number of routes designated as bicycle facilities
	Number of attractions within a threshold travel time
	Ratio of non-auto to auto travel costs, including travel time and money
	Access to centers
	Ratio of jobs to housing
Improved quality of existing transport options	Satisfaction with transportation options
	Person-hours of delay
	Average delay per trip; percentage of person-miles by level of service; intercity travel time minus (straight-line distance divided by the speed limit)
Improved public services or economic growth	Response time for fire, police, and rescue and travel time for schools
	Cost of above municipal services (fire, police, rescue, schools)
	Reduction in consumer costs attributable to better transport
	Ratio of actual corridor travel time to free flow travel time
Protects or manages corridors	Number of jurisdictions that protect land adjacent to airports from development
	Miles of roadway with agreements between state DOT and local government
	Alignment of strategic highway corridors and land use overlay
	Arterials where an access management plan has been established
	Percent interregional corridor miles with corridor management/land use plans
	Agreements between state and local plans
Align state and local efforts	Locations where State and integrated transportation studies are undertaken
	Jurisdictions with current active local plans
	Customer satisfaction with coordination
	Customer/stakeholder satisfaction rating
	Transportation project listed in the regional transportation plan
Reduced land consumption (and other environmental measures)	Percent of jobs or population in urban centers
	Population density
	Conversion of undeveloped land
	Loss of farmland, open space, habitat, forest land acreage or loss of historic resources or of specified/designated visual assets
	Loss of wetlands
	Measured O_3, NO_x, CO and estimated (or measured) CO_2

Source: Reference 20, p. 47

Table 3-2

Transportation Sustainability Indicators

Category	Subcategory	Indicator	Disaggregation	Rating
Travel Activity	Vehicles	Motor vehicle ownership	By type of vehicle, owner demographics, location	A
	Mobility	Motor vehicle travel	Trip type, traveler type, travel conditions	A
	Mode split	Portion of trips by auto, public transit /non-motorized modes	Trip type, traveler type, travel conditions	A
Air Pollution Emissions	Emissions	Total vehicle emissions	Type of emission, mode, location	A
	Air pollution exposure	Days of exposure per year	Demographic groups affected	A
	Climate change	Climate change emissions (CO_2, CH_4)	Mode	A
	Embodied emissions	Emissions from vehicle and facility construction	Type of emission and mode	A
Noise Pollution	Traffic noise	People exposed to traffic noise above 55 LAeq, T	Demographic group, location, transport mode	B
Traffic Risk	Crash casualties	Crash deaths and injuries	Mode, road, type/cause of collision	A
	Crashes	Police-reported crashes	Mode, road, type/cause of collision	A
	Crash costs	Traffic crash economic costs	Mode, road, type/cause of collision	B
Economic Productivity	Transport costs	Consumer expenditures on transport	Mode, user type, location	A
	Commute costs (time & money)	Access to employment	Mode, user type, location	A
	Transport reliability	Per capita congestion costs	Mode, location	B
	Infrastructure costs	Expenditures on roads, public transit, parking, etc.	Mode, location	A
Overall Accessibility	Mobility options	Quality of walking, cycling, public transit, driving, taxi	Trip purpose, location, user	A
	Land use accessibility	Quality of land use accessibility	Trip purpose, location, user	B
	Mobility substitutes	Internet access and delivery service quality	Trip purpose, location, user	B
Land Use Impacts	Transport land consumption	Land devoted to transport facilities	By mode	B
	Ecological/ cultural degradation	Habitat/cultural sites degraded by transport facilities	Type of habitat and resource, location	B
Equity	Affordability–transport	Portion of household budgets needed to provide adequate transport	Demographics, especially disadvantaged groups	A
	Basic accessibility	Quality of accessibility for people with disabilities	By geographic area, mode, type of disability	B
Transport Policy and Planning	Pricing efficiency	Cost-based pricing	By mode, type of cost (road, parking, etc.)	B
	Strategic Planning	Degree to which individual planning decisions support strategic goals	By mode, by agency	B
	User satisfaction	User survey results	By group (people with disabilities, children, low income, etc.)	B

This table lists various possible sustainable transportation indicators. Ratings indicate priorities: A = Proposed for application in virtually every situations and jurisdictions; B = Proposed for application if relevant/feasible.

Source: Reference17, pp. 8-9

Campus Strategic Transportation Plans

A successful campus master plan requires cooperative planning efforts between the university, public agencies, and neighboring communities. Campus master plans typically address a wide range of interrelated topics, such as transportation, land use, general infrastructure, campus safety and security, intergovernmental coordination and public relations, conservation and efficiency, and capital improvements. Campus transportation plans are used to manage the multimodal campus traffic and integrate campus transportation systems with metropolitan transportation systems [8].

Campus transportation planning is one of the most important elements within a campus master plan for many universities. The transportation component of a university master plan addresses the current and future transportation facilities and services on and around the campus to meet the transportation needs of campus users and adjacent communities. Transportation-related practices must be based on various modes of travel with relevant planning elements and goals [22].

Campus transportation plans are used to manage multimodal campus traffic and integrate campus transportation systems with metropolitan transportation systems. Major components considered in a comprehensive campus transportation plan include common planning goals, modes of travel, and planning elements and other transportation-related components [22]:

- Collaborative transportation planning
- Pedestrian and bicyclist safety
- Transit-related practices
- Collaboration on transit services
- Ridership incentives
- Parking-related practices
- Campus parking management
- Campus resident parking
- Motor vehicular traffic practices
- Campus vehicular traffic control
- Vehicular traffic and parking demand reduction
- Vehicular traffic accessibility

The mix of concentrated levels of pedestrian and bicycle traffic with vehicular congestion in a campus setting creates significant conflict areas that range from pedestrian and cyclist safety to traffic and transit operations. Integrating transportation systems with university campus master plans offers efficient,

sustainable approaches to improve pedestrian and bicyclist safety, convenient and efficient access to the university campus and surrounding neighborhoods, and enhanced attractiveness and character of the community. Collaborative integrated transportation systems planning includes the university, city, and region [8].

Aldrete-Sanchez [22] conducted a comparison analysis to identify the best practices pertaining to campus transportation planning and management. Three levels were identified: least advanced, moderately advanced, and most advanced. Practices were grouped under each stage, as shown in Table 3-3. These practices were categorized based on perceptual effectiveness, representativeness of the technology trends, consistency with contemporary transportation developments, and applicability on other campuses [22].

Table 3-3

Campus Transportation Planning Best Practices Analysis Matrix

Least Advanced	Moderately Advanced	Most Advanced
Collaborative Transportation Planning		
Limited or no coordination with local planning agencies (LPAs) & other stakeholders	• Coordination with some LPAs and stakeholders on a limited number of planning topics (e.g., transit and/or congestion management)	• Extensive coordination with all affected LPAs (e.g., City, County, State Department of Transportation) and stakeholders on most/all transportation topics: transit, parking, pedestrian/bicycle, congestion management, environmental impact
Pedestrian and Bicycle		
• Minimum provisions for pedestrian mobility and accessibility—narrow sidewalks, inconvenient pedestrian crossings, lack of sidewalk connectivity, etc. • Limited or poorly maintained bicycle routes; limited bicycle facilities (e.g., racks) • No pedestrian and bicycle incentives • No pedestrian and bicycle safety programs • No coordination with LPAs on pedestrian and bicycle planning	• Network for basic pedestrian mobility and accessibility needs; limited number of shaded paths, seating areas, grade-separated crossings, • Some bicycle routes; basic bicycle facilities (e.g., racks, shaded parking spaces, etc.) • Limited pedestrian and bicycle incentives • Basic pedestrian & bicycle safety measures (e.g., routine traffic control, dedicated routes) • Some collaborative planning for limited connectivity, but barriers on or around campus exist	• Extensive pedestrian network with enjoyable walking environment connecting to all major campus buildings, transit stations, other popular pedestrian destinations • Extensive bicycle network with large numbers of exclusive bicycle paths, shaded bicycle parking, bicycle lockers, clothes lockers, showers, maintenance centers • Safe-walk programs, pedestrian transporters (e.g., HTs, APMs, and PRTs), bicycle sharing programs, bicycle purchase incentives, etc. • Pedestrian & bicycle safety education programs; use of advanced technologies (e.g., GIS and ITS) for safety improvement; safety equipment (e.g., helmets, flashers, and safety vests) sharing programs • Collaborative planning on pedestrian & bicycle safety & network with maximum accessibility & connectivity on & around campus
Transit		
• No or limited transit services and routes on campus; no pedestrian friendly facilities at stations • No ridership incentives • No collaborative transit planning with local transit providers	• Regular transit services provided by both university and local providers; limited facilities (e.g., shelters, seating, and lighting) at transit stops • Basic ridership incentives such as fare discount for students • Basic collaborative planning on routes, stops, and fare price	• Adequate transit services on or around campus; convenient facilities (e.g., shelters, seating, lighting, emergency phone system, drinking fountains, etc.) at most transit stops; use of transit malls and hubs • Multiple ridership incentives such as little or no cost for students & employees, extended services during after hours, ready accessibility to transit stations, park & ride facilities, class schedules in coordination with transit availability & ITS for transit vehicle location and schedule information • Well-coordinated planning on transit services on or off campus for maximum connectivity & consistent service
Parking		
• Poorly managed, enforced parking facilities; no/very limited visitor parking • No regular parking inventory and/or studies; discrepancies between parking capacity, permits issued • No parking management in surrounding neighborhoods	• Fairly designed parking facilities; regular enforcement; limited traffic signs for locations; some visitor parking spaces • Limited parking inventory studies; moderate discrepancy between parking capacity & permits issued • Limited involvement in managing student parking within surrounding neighborhoods	• Well-designed and managed campus parking facilities; off-campus parking facilities with reliable shuttle service and safety measures; advanced parking management and information tools (e.g., APMS, DMS, Internet); convenient & clearly guided visitor parking • Regular parking inventory studies; clear understanding of parking availability and demand; up-to-date parking management strategies • Extensive collaboration & involvement in parking management within surrounding neighborhoods using mechanisms (collaboratively managed parking districts)
Motor Vehicle Traffic		
• No or implicit policy statements discouraging use of personal vehicles in campus plans • Limited traffic control at very few entrances • Vehicular traffic restriction primarily by parking availability • No particular incentives for carless commuting	• Statements included in campus plans emphasizing the importance of pedestrian, bicycle, and transit modes on campus • Traffic control at major campus entrances • Parking management skills used for vehicular traffic reduction, such as preferential parking for carpoolers/ vanpoolers & infrequent drivers • Basic incentives for commuting by bicycles or transit as previously noted	• Policy statements in campus plans & explicitly rank pedestrian, bicycle, & transit as high-priority modes of travel on campus; personal vehicles are the least preferred • Traffic control at all major campus entrances as well as other strategic locations; campus roads with heavy pedestrian traffic closed to motor vehicles; sufficient auto accessibility for emergency events • Flexible working schedules; class schedule & location with consideration of parking availability and avoiding peak hours; use of telecommunication technologies • Guaranteed emergency ride home programs for people who commute by alternative modes; systematic incentive programs to encourage all alternative modes; other innovative incentives (campus access fees with rebate for use of alternative modes)

Source: Reference 22, pp. 13-14

Land Use and Transit

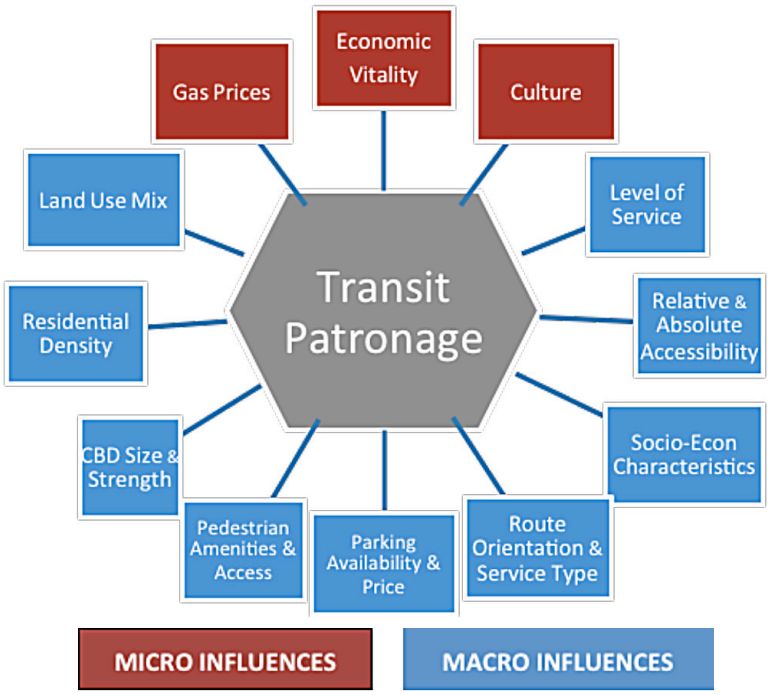
University institutional policies and land use planning decisions have a great influence on sustainability efforts, including transportation. The location and amount of student housing and student employment greatly influence travel mode selection and are key planning elements that impact campus transportation planning. Transportation policies and campus infrastructure will largely determine the appearance and feel of the campus. Decisions about parking will affect the amount of green space, the amount of impervious surface, and the amount of land available for buildings [11].

Mode choice is affected primarily by density and land use. A key planning decision that affects transportation is the number of students on-campus and the degree to which activities are spread across satellite campuses [11, 12]. Land use and urban development strategies alter demand by reducing trip length (by providing a choice of close-by destinations) or by making alternatives to the SOV more competitive and cost-effective. Through compact and mixed-use development, higher development densities can reduce trip lengths and make transit, pedestrian, and bike use practical, affordable, and safe. Land use strategies promoting infill, compact development, and mixed use are promoted in numerous cities and suburbs and are applicable to universities as well [12, 23].

Research suggests that vertical mixed use close to transit access and retail plays an important role up to ¼ mile from transit service. Retail use is positively related to transit demand both within ⅛ and ¼ mile of a transit stop. Density adjacent to a transit line may not play as critical a role as density in the larger surrounding area. The greater the difference between housing-based and employment-based land uses, the lower the demand for transit [23, 24].

In addition to density, transit ridership often appears to be a function of size of the central business district (CBD) and the distance from downtown as well as parking supply and price, transit service quality, pedestrian accessibility, and land use mix, as illustrated in Figure 3-1).

Figure 3-1
Influences of Travel Demand



Source: Reference 24, p. 24

The relationships between transportation and land use are complex. Comprehensive analysis of transportation land use impacts includes consideration of lands used for transportation facilities; the location, type and cost of development; accessibility and travel options; and travel behavior [20].

According to Ewing and Cervero [26], planning measures that could be taken to enhance transit ridership include the following:

- Any drop in automobile trips with greater accessibility, density, or mix is roughly matched by an increase in transit or walking/biking trips.
- Trip lengths are generally shorter at locations that are more accessible, have higher densities, or feature mixed uses. This holds true for both home-end and non-home-end trips.
- Of all travel variables, mode choice is most affected by local land-use patterns. Transit use depends primarily on local densities and secondarily on the degree of land-use mixing. Walking depends as much on the degree of land-use mixing as on local densities. A pedestrian-friendly environment is not the same as a transit-friendly environment.
- For both transit and walking, employment densities at destinations are as important as, and possibly more important than, population densities at origins.

Travel Demand Management

In creating a more sustainable transportation network, many universities are implementing TDM programs to influence the transportation behavior and modal choices of students, employees, and visitors. TDM is a coordinated set of policy and operating strategies that include a combination of incentives for walking, bicycling, taking public transit, ridesharing and discouraging the use of SOVs by passing on the full costs of parking to drivers and linking transportation planning to land-use planning [9, 27].

Sustainability strategies attempt to stimulate non-automobile commuting through TDM, integrated land use, operations management, pricing policies, vehicle technology improvements, clean fuels, and transportation planning [12]. TDM goals are to reduce automobile use, encourage other travel modes, and promote environmentally-friendly and sustainable vehicle types and fuels. These strategies include market prices for parking, expanded transit access, park-and-ride lots complemented by bus shuttles, rideshare programs, bicycle and pedestrian facilities, traffic-calming measures, and alternative fuels. Most TDM goals are inherently sustainable and promote livable communities by mitigating transportation inequity, offering better affordability, fostering the development of the overall economy of the community, and reducing environmental impacts [9].

Because they can control key elements of TDM, especially parking availability, parking rates, and land-use, universities are able to more easily implement coordinated programs of incentives and disincentives to SOV travel [27]. The most important determinants are the supply and price of parking, land-use plans that determine the length and type of trips, financial incentives to drive alone or travel in other ways, level of transit service available, and ease of bicycle use [16]. Individual TDM strategies have a modest impact on the transportation system, but when multiple strategies are applied in a coordinated manner, the impact on mode choice can be substantial [9].

Parking fees are an essential component of a TDM program because raising fees serves as a disincentive to SOV use and high parking fees can generate the revenue needed to fund other elements of the TDM program and transportation options [27].

In addition to parking pricing, parking restrictions, unlimited-access transit, and transit service improvements are important TDM strategies. It appears that all TDM policies play at least some role in creating a modal shift; without effective pedestrian infrastructure, bus riders could be left in an unsafe environment that would be detrimental to transit ridership [9, 26].

A truly integrated TDM program may result in many environmental and societal benefits by enhancing the use of existing transportation systems. If fewer cars are traveling to campus, then fewer parking spaces are required, lower

maintenance costs are incurred, and the land currently used for parking can be converted to other uses, such as open space. This can only happen if, in addition to a comprehensive approach to promote alternative transportation modes, SOV use is restrained or charged at full cost and the funds redistributed to improve those alternative options [13].

Toor and Havlick [16] provide a good summary of 18 TDM strategies based on financial incentives and parking management (see Table 3-4). Each strategy includes a description, opportunity, limitations, effectiveness, and cost to implement the various TDM strategies. They also identified 13 sustainability market-oriented TDM campus strategies, as shown in Appendix A.

Table 3-4

TDM Strategies Based on Financial Incentives and Parking Management

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Free transit passes	Implemented as either student or employee unlimited access transit pass program.	Unlimited access transit passes provide travelers with motivation to use transit; these have been successful in encouraging high transit ridership in many college towns.	To be effective, adequate transit service must be available.	High (mode share); High (VMT reduction)*	High
Parking fees	Can be set for cost-recovery or variable based upon time of day and length of parking.	Effective in providing disincentive for traveling alone to work. If convenient alternatives available, a shift of up to 25% to alternative modes is possible	Spillover traffic will be a concern, unless aggressive parking permit program is pursued. "Sting" effect of parking charges wears off over time, reducing long-term benefits.	High (mode share); High (VMT reduction)	Neutral. Fees used to recover cost of parking facilities and enforcement
Transportation allowance	Provided to commuters for use on whatever modal options they choose. Typically, allowances used with parking pricing and other modal strategies.	Very effective at "leveling" playing field between parking and alternatives. Opportunity to save money and avoid out-of-pocket parking costs appealing to many.	Spillover parking will occur unless policy also has neighborhood parking restrictions. Allowance will work best where alternatives are readily available.	High (mode shift); High (VMT reduction)	Low if policy is structured to be relatively cost-neutral; high if costs cannot be recovered through higher parking fees
Car-Sharing	Pooled fleet of vehicles available for limited tasks by either members of a carshare program (similar to a timeshare) or for a per-use fee.	Similar GRH by using alternatives easier for travelers. Can reduce need for vehicle ownership, which also reduces vehicular use in general.	Limited application in US; difficult to project potential effects. Cost recovery over time becomes an issue, especially administration/ maintenance.	Medium (mode share); High (VMT reduction)	High; however, cost may be partially recovered by membership and user fees

Table 3-4 (cont.)

TDM Strategies Based on Financial Incentives and Parking Management

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Commuter Club	Similar in function to "airline miles"; provides either points or cash-based incentives to commuters who use alternative modes of transportation.	Provides tangible incentives and recognition to those who use alternative modes.	Development has some associated financial/administrative expenses.. As with other TDM promotions, a will only be as effective as convenience of available alternatives.	Medium (mode share); Medium (VMT reduction)	Medium
Guaranteed Ride Home (GRH)	Provides free taxi home to those who fall ill, have an emergency, or are left stranded by a carpool.	Having a guaranteed way to avoid being "stuck at the office" is a desirable incentive. Allows employees to always have a ride home, regardless of emergency or situation. GRH rarely abused nationwide.	Main limitation is ensuring that a commute trip reduction program is implemented for GRH to be effective. Employers may also hesitate to provide GRH due to costs and liability; costs are usually low.	Medium (mode share); Low (VMT reduction)	Low
Incidental use parking	Spaces dedicated for use by an "irregular" driver such as transit rider or carpooler who must drive to work on occasion.	Very effective in managed or priced parking lots (as an added incentive similar to GRH).	Limited effectiveness without parking pricing of some kind.	Medium (mode share); Low (VMT reduction)	Neutral
Parking cash out	Allows employees opportunity to choose parking space or receive cash equivalent of space. Works best when parking spaces are unbundled from leases.	Very effective at "leveling the playing field" between parking and alternatives; opportunity to save money and avoid out-of-pocket parking costs is appealing to many travelers. Can reduce SOV commuting by up to 25% if alternatives are readily available.	Employees may claim to commute by alternative modes but actually drive by themselves and park off-site, creating spillover parking problems. Overcoming various institutional and political barriers may be difficult.	Medium (mode share); Medium (VMT reduction)	Low if structured so that costs can be recovered through higher parking fees; high if costs cannot be recovered
Parking management	Strategies that balance availability of parking with the availability of modal alternatives. Residential/commercial parking permits, parking pricing, shared use parking, time restrictions, and other strategies are included in general parking management.	Limits the availability of free and subsidized parking. As with transportation allowances, parking management levels the playing field thereby allowing greater use of alternatives, as they are perceived to be more convenient.	Parking that is difficult to find, inadequate, inconvenient, or expensive will frustrate users and can contribute to spillover parking problems in other areas.	Medium (mode share); Medium (VMT reduction)	Medium

Table 3-4 (cont.)

TDM Strategies Based on Financial Incentives and Parking Management

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Taxation incentives	Provide and/or promote the availability of tax benefits for the use of alternatives. Currently, federal tax law permits pre-tax allocation of certain alternative transportation expenses.	Commuter choice benefits offer up to $100 per month for transit or vanpool expenses and up to $180 per month for parking. Commuter choice initiatives have shown to be effective with employees nationwide.	Commuter choice programs and regulations are sometimes difficult to declare pre-tax expenditures on payrolls. As such, implementation by small and medium size employers should be limited.	Medium (mode share); Medium (VMT reduction)	Neutral. Employers may actually save money on reduced payroll taxes
Bike checkout program	A bike checkout program provides a set of bicycles for student or employee use. Bicycles are associated with either an individual or a department for tracking & maintenance purposes.	Greater flexibility for those who do not use an SOV as their preferred commute method and provided an alternative for short-distance errands.	Program requires administration to ensure safety and security of bicycles is maintained.	Low (mode share); Low (VMT reduction)	Medium
Clustered parking	Clustered parking (including parking structures), reduces pedestrian distance between buildings and improves ambient quality for pedestrians.	Creates safer, more attractive pedestrian-friendly environment behind buildings, encourages clustering of buildings. Safer environments have been proven to attract greater numbers of pedestrians and cyclists.	Campus master plan may need to be rewritten to support these parking practices.	Low (mode share; Low (VMT reduction)	High cost for parking structure construction; cost may be recovered from users
Parking maximums	Ensures that a campus does not over-supply parking, which creates an imbalance between modal options. Parking maximums can be jointly negotiated between a campus and municipality or county.	Cities across the U.S. have used maximums to varying levels of success in reducing SOV traffic. Campuses are well-suited to this approach since supply of parking is controlled by campus administration.	Often do not have immediate results. Even established sites with excellent transit service can be overrun with vehicles demanding parking.	Low (mode share); Low (VMT reduction)	Neutral
Preferential parking	Provide parking spaces for carpoolers and vanpoolers near the front entrances, which typically require a hang tag or other identification mechanism for use.	Provides incentives for those in carpools and vanpools to have the most desired parking spaces. Successfully implemented at employers and at many campuses nationwide.	Parking that is difficult to find, inadequate, inconvenient, or expensive will frustrate users and can contribute to spillover parking problems in other areas.	Low (mode share); Low (VMT reduction)	Low cost (parking signs and hang tags run less than $100 per space)

Table 3-4 (cont.)

TDM Strategies Based on Financial Incentives and Parking Management

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Unbundled parking leases	Separating parking from building leases provides an opportunity to offer a transportation allowance or other cost-neutral promotion of alternatives, without incurring any additional cost for "wasted" parking.	Allows for opportunity to pursue transportation allowances or parking cash-out, an important issue for university housing.	Spillover parking needs to be addressed on surrounding streets. Without parking cast-out or transportation allowances, unbundling leases will not accomplish SOV or VMT reduction goals.	Low (modal share); Low (VMT reduction)	Neutral, depending upon cost-recovery plan
Vanpool empty seat	As vanpools lose riders over time (when someone's job changes), the empty seat subsidy ensures that other riders have a consistent user fee. The cost of the lost rider in the van until a new rider is found, or at least for a minimum time.	Ensures that cost for other users will not increase for users who continue in vanpool (tends to have lowest cost per passenger-mile of any motorized mode) , since it makes use of a vehicle seat that would otherwise be empty.	To be effective, empty seat subsidy should expire to provide incentive for actually finding a replacement rider. Requires an efficient matching system.	Low (mode share); Medium (VMT reduction)	Low cost (typically $100 per month per empty seat).
Vanpool subsidy	Subsidizing the monthly cost for using a vanpool greatly increases cost-savings incentive for participating in a vanpool. Typical subsidy is 30% to 50% per seat.	Provides financial incentive to first-time vanpool users to have a "trial" period that allows user to directly compare personal cost savings by not driving vs. eventual van use cost.	Requires efficient matching system to be effective.	Low (mode share); Medium (VMT reduction).	Medium
Free bicycle accessories	Providing bicycle accessories to commuters (e.g., headlamps, helmets) can improve safety of bicyclists and serve to encourage greater use of bicycle commuting.	Can alleviate safety concern of bicyclists. Promotes use of bicycles as viable alternatives	Equity concerns are most apparent, so as not to compete with retailers. Free accessories may only serve to reward those who are already bicycling.	Marginal (mode share); Marginal (VMT reduction).	Low

*Mode share refers to the percentage of trips shifted out of single occupant vehicles; VMT reduction refers to the reduction in vehicle miles traveled. Shifting longer trips out of cars will have a larger effect on VMT than shorter trips.

Source: Reference 16 (modified with permission from the *City of Boulder: Boulder TDM: Strategies and Program Options*, LSA Associates, June 2002)

Transit

The majority of the daily trips made by students, staff, and faculty to the university are made to its central campus core. This fact provides many transit agencies and university administrations with an opportunity to rethink the way they have approached serving the transportation needs of the university community [15].

Transit can deliver large numbers of people to a destination with much less impact on vehicular level of service compared with the automobile. It is common that universities collaboratively plan and manage transit service on their campuses with external transit providers in terms of fare/pass, schedule, routes, and terminal locations to maximize serviceability, flexibility, and connectivity [15].

Transit systems that serve university communities differ from one another with regards to asset ownership, operation, and governance. Universities, transit agencies, private contractors, and local governments often own transit system assets. The transit systems can be operated by transit agencies, universities, or public contactors [29].

According to Krueger and Murray in the Transit Cooperative Research Program (TCRP) publication *TCRP Synthesis 78* [14], transit service provided to universities generally falls into the following six categories:

1. Designed to meet the "home to school" trip, reducing the number of vehicles traveling to campus.
2. Serves students living in high-density corridors, reduces the cost of higher education, serves students living in outlying areas or communities.
3. Shuttle services from outlying parking, providing internal campus circulation to avoid those trips being taken by automobile, providing mobility where automobiles are prohibited, providing mobility where the campus is of such a size that there is insufficient time to walk between classes.
4. Reduces congestion (all modes) in heavily-used corridors.
5. Shuttle services around the main campus.
6. General public service that passes the periphery of campus [14].

Increasing transit ridership is not solely tied to fare cost. To attract more riders, service must also be improved. The most important service characteristics for non-users of transit are increased frequency and direct routes from home-to-work. Cervero [30] found that service frequency was twice as important to riders as fare cost. The wait time for a bus is a substantial component of total travel time. When the time waiting for a bus can

be reduced, transit begins to become competitive with the private automobile in terms of convenience. Bus wait time is considered part of total travel time [9].

Transit is essential to university TDM programs and an effective sustainable transportation system. Universities can often enhance transit availability on campus by partnering with a local agency. The financial support from universities can significantly assist local transit agencies that serve students, faculty, and staff as a major component of their customer base. They tend to have significantly higher per-capita ridership figures than do other comparably-sized areas, and the specific routes serving a campus are often the most heavily used [14, 31]. Successful campus transit systems include factors such as careful planning, understanding user preferences, efficient design of system services, and coordination with existing city transit service [27].

Investments in transit improvements can attract riders through provision of high-quality service that competes with the comfort of travel by car. These transit characteristics include roadway enhancements, transit stop amenities (such as benches and information signs), and on-vehicle systems (such as GPS technologies), as well as programmatic improvements such as high-frequency and late-night service [14].

Universities frequently offer ridership incentives to encourage students and employees to use transit, such as fare discounts or free services for riders with valid university IDs. Some universities have transit malls/hubs at locations with high pedestrian volume to facilitate the use of transit services. Improving conditions at transit stops by providing shelters, lighting, and safety measures and service flexibility can also be effective in increasing transit ridership. In addition, universities may consider bikes-on-buses or comparable programs for off-campus bus routes that encourage both transit ridership and bicycle usage. Common challenges for university transit services include funding availability, service frequency, and transit capacity at peak hours [22, 32]. To enhance transit services, transportation agencies are decreasing headways and increasing service amenities such as providing passengers with real-time schedule information through ITS [13].

Unlimited Access

Universities are working in collaboration with transit agencies across the country to provide transit pass programs, which are considered to be a key TDM transit strategy for urban campuses. Unlimited-access transit often is provided through a fee agreement between a university and a local transit operator. The university typically pays the local transit agency an annual lump sum based on expected student ridership, and students show their university ID to board the bus [9, 27]. This has often led to an increase in transit use and may encourage some people to shift from driving to campus to riding transit,

which can free up some campus parking spaces. At many universities, students have voted to increase their fees to allow any student with a valid university ID to ride local or regional routes fare free. Faculty and staff transit passes are either paid by the university through general funds, from parking revenues, or by optional fees paid by individual employee [28].

Through unlimited-access programs, students and employees are fully or partially subsidized and benefit from inexpensive transportation. The university benefits from decreased parking supply costs and improved community relations by reducing off-campus traffic [33]. In addition, unlimited access reduces parking demand, increases student access to the campus, helps to recruit and retain students, and reduces the cost of attending college. Transit agencies report that unlimited access increases ridership, fills empty seats, improves transit service, and reduces the operating cost per rider [15, 34].

Parking

The cost to park has a strong influence on the overall university transportation network, as the balance between price and supply can result in a more efficient use of available facilities. Most universities manage their limited on-campus parking spaces using parking permits that are available for purchase by faculty, staff, and students. As such, parking pricing has been widely used as a mechanism to leverage parking availability and demand [22].

Visitor parking facilities and metered parking spaces are provided on many campuses for short-term parking at higher costs. Many universities also have off-campus parking lots connected by shuttle buses at little or no cost to employees and students. When off-campus parking lots are available, it is important to provide secure bike parking facilities, frequent shuttle services, sufficient lighting, and security patrols and cameras to ensure connectivity and safety [22].

Universities have generally been charging parking fees that are less than the actual cost of this infrastructure, which results in the university subsidizing parking costs. At many universities, there is limited available land, so that expanding the parking supply will mean a shift from surface parking to structure parking. The cost of long-term debt for these structures and the parking price increases that would be required would be very large. Toor and Havlick [16] recommend that parking fees be raised to the level required for construction before committing to the construction; this would help determine the impact on demand before obligating to long-term debt.

Decreased subsidization of parking by universities can not only decrease the attractiveness of driving, but can also provide funds for TDM strategies. A review of universities by Toor and Havlick [16] showed that increased parking fees are one of the most effective strategies that can be employed to reduce SOV use.

According to Ripplinger [35], there is a strong relationship between parking and transit in university communities. Parking shuttles provide mobility between lots and destinations and parking fees are often used to fund transit. Increases in the cost of parking may shift drivers to other modes of travel, including transit. These shifts may also mitigate traffic concerns both on-campus and community-wide.

Universities can often generate traffic and overflow parking into neighboring communities, creating community-relation problems that are often called "town-gown relations." Students or university visitors frequently park on nearby neighborhood streets, resulting in traffic safety and parking problems at these locations and complaints from neighboring communities [8].

A convergence of interests exists between a university's desire to provide cost-effective access to campus and the community's desire to reduce off-campus traffic and parking impacts. These interests can include joint planning and funding of bicycle, transit, and pedestrian improvements in the campus and surrounding area. Some cities have also implemented residential parking permit (RPP) zones on nearby residential streets. RPP programs allow residents to purchase full-time parking permits, often for a nominal fee, while restricting nonresident parking [11].

Bicycles

Bicycle infrastructure planning and policies that encourage cycling are important elements of a campus TDM program. Bicycles are the most efficient form of transportation, with the lowest energy input and lowest output of pollutants and GHGs. Campus populations are well-suited to bicycle use. Active transportation, such as bicycling and walking, can also contribute to the health of the campus population [11, 15, 25].

Bicycle racks at transit stops and on the front of buses facilitate transfers between bicycle and transit, possibly encouraging a mode shift from SOVs to other modes. Likewise, bike lockers for faculty, staff, and students provide commuters with a secure place to leave their bicycle during the day, simplifying a bicycle commute. The amount of investment in bicycle infrastructure on campus can indicate the level of support for alternative mode travel around the campus [11].

The cost of one bicycle parking space (about $100) is less than one percent of the cost of one new automobile parking space. Some campuses have invested in additional features such as covered bicycle parking, grade-separated crossings for bike paths, bicycle signal heads at signalized intersections, full-service "bike stations" with secure parking and repair service available, free bicycle checkout for students and employees, and even zero-interest loans for bicycle purchases by students [36].

There is a growing interest in bike-share programs in communities and universities. Through bike-share programs, there are networks of public-use bicycles distributed around a city or university for use at low cost. Bicycles can be picked up at any self-serve bike station and returned to any other bike station, which makes bike-sharing ideal for point A to point B transportation. Capital and operating costs for station kiosks are significant, resulting in funding models employing both federal and local funding and corporate and foundation sponsorships and advertising. User memberships and fees may support some operational costs such as marketing and redistribution of bicycles.

Technology and Green Innovations

New technologies are being implemented by universities that are designed to improve transit operations and enhance the experience of transit riders. In addition, universities are adopting more comprehensive strategies for reducing vehicle emissions and enhancing opportunities for campus access by modes other than single occupancy vehicles. New technologies provide opportunities to enhance transit operations along with other soft approaches such as teleworking, flextime, adjusting university class schedules, and distance learning.

Teleworking allows an employee to work at home one or more days a week. Flextime can decrease rush-hour congestion and replace traditional workweeks with more flexible schedules. Increasing the use of distance learning can decrease the need for additional parking by delivering Web-based classes [27].

Many campuses are switching to cleaner fuels such as biodiesel, which can be used in existing diesel-burning vehicles [11]. The partial replacement of university fleets with alternative fuel, hybrid vehicles, and technologies such as compressed natural gas or electricity is being used by a growing number of universities. Some universities are recycling fluids such as vegetable oils from university kitchen operations in their "veggie" buses [14].

Some universities have begun to implement campus-owned vehicle programs (for institutional use) or car-sharing programs. These programs and technologies can enhance the campus environment and increase livability, including for people who cannot or do not want to drive [14].

Transit Vehicle Technologies

Numerous technologies exist that can improve transit operations, customer satisfaction and safety, including onboard vehicle systems, roadway technologies, bus lanes and bus pullouts, roadside improvements (stops and shelters), information technologies such as marketing technologies through the Internet and real-time bus information systems, and other technologies such as passenger information and signage [14].

Bus stop pull-outs allow vehicles to move out of the flow of street traffic before loading and unloading passengers which reduce operating conflicts in mixed traffic. Also, pavement markings designating bus stop locations can help reduce transit delays [14].

Other Transit Vehicle Technologies

Technologies on board transit vehicles are designed to improve rider experiences. Automated stop announcements can assist new riders or those using an unfamiliar route. Management of transit operations are facilitated through automated passenger count (APC) systems by providing detailed data about how many people get on and off at each stop. Many transit systems use radio communications, public announcement systems for communication between the driver and riders, and automated stop announcements. Many transit operations still rely on the driver to handle dissemination of most on-board navigation information to customers and to conduct manual passenger counts. [14].

While not widely used in university transit vehicles, automatic vehicle location (AVL) technology can assist customers by conveying real-time transit information. Vehicle arrival information systems use the vehicle location, stops, and typical traffic conditions to estimate how many minutes before the next bus arrives at a particular stop location. On the other hand, vehicle location information systems monitor the position and motion of the vehicles en-route and report the vehicles' current locations and next transit stops [14].

AVL-equipped buses with graphic user interfaces can produce detailed route maps displaying a transit vehicle's current location. The maps and information can be viewed online via a Web-enabled phone or handheld computer, received by text messages, and/or displayed at transit stops [14].

Customer Information

Transit places a high priority on providing information to its riders. Transit schedules and route maps are most often distributed through on-board paper schedules and transit route maps; they are also usually available from the transit agency website as well. Static and electronic information boards and kiosks are also used for postings [14].

The recent explosion in the use of social media has created great opportunities for transit agencies to connect with university customers who are primarily young students. These Web-based technologies encourage users to interact with each other. Recently, TCRP Synthesis 99, Uses of Social Media in Public Transportation was published, which demonstrates the growing importance of these media [40].

Alternative-Fueled Vehicles

Universities offer a niche market for alternative fuels vehicles because university fleets are often fueled centrally and travel ranges are limited. Campus maintenance vehicles and shuttle buses that use alternative fuels are frequently purchased because of fixed routes and limited travel ranges. Many transit providers now use alternative energy sources to fuel the vehicles in their fleet, including environmentally-friendly fuels. Alternative fuel technology options include hybrid electric vehicles, compressed natural gas, propane, ethanol, electricity, biodiesel, and hydrogen [14, 36].

Summary

Universities are distinct communities with unique transportation needs. Maintaining university quality of life and environmental values while minimizing impacts on neighboring communities is challenging. Over the next decade, universities are expecting enrollment to continue to grow, which will result in increasing congestion and parking problems. Universities are in an excellent position to experiment with and implement transportation policy changes. Through institutional policies and planning decisions, universities have direct control over the road network, parking facilities, and land uses on their campuses.

There is a growing interest by universities to adopt sustainability measures, particularly in transportation. TDM is the key strategy employed to reduce SOV usage and promote other non-motorized travel in, and around, campus. Campus strategic transportation plans are used to manage multimodal campus traffic and integrate campus transportation systems with metropolitan transportation systems.

A review of the literature shows that there is limited documentation on the various interactions of transportation modes (auto, transit, bicycle, and pedestrian) within a campus setting or the systematic integration of these different modes with the larger transportation system [8]. Information on multi-nodal campuses and related coordination and integration challenges is not found in the literature.

The literature also is limited is discussing the unique context in which universities function because of population mix, irregular schedules, and continual movement of people throughout the day [13]. Universities with two or more geographic campus locations require a transportation system to connect them. These multi-nodal campuses create a significant challenge for university campus planners when trying to integrate and coordinate university transportation into the overall regional or metropolitan transportation systems.

A wide variety of strategies is available to meet the needs of different types of institutions and a broad set of approaches a university can take to influence the transportation behavior of students, employees, and visitors. The most important determinants are the supply and price of parking, the land-use plans that determine the length and type of trips, the financial incentives to drive alone or travel in other ways, the level of transit service available, and the ease of bicycle use. The decisions planners make in these areas will have a very significant impact on transportation mode share [11].

SECTION
4

Multi-Nodal Campus Case Studies

Introduction

To make campuses more pedestrian/bicycle-friendly, livable, and sustainable, universities are using innovative programs and implementing transportation plans to reduce parking demand and promote alternative modes of transportation. The focus of this section is to identify multi-nodal university campuses that have innovative TDM programs that promote successful alternative transportation programs and practices.

Through institutional policies and planning decisions, universities have direct control over the road network, parking facilities, and land uses on their campuses. This enables them to be innovative in developing transportation options and facilitates collaboration with public agencies and adjacent communities. Sustainability policies can enhance not only the university's transportation system, but also the transportation system of the surrounding community [9, 10].

Campus Transportation Plans

According to the U.S. Department of Education's National Center for Education Statistics, there are 2,774 four-year public and private universities in the U.S.; only 560, however, are participating in one or more sustainability-rating organizations [37].

With respect to universities with multiple campuses, transportation master plans typically have not identified transportation coordination or connectivity difficulties among/between campuses. For multiple-campus universities, transit services and university shuttles have a wide range of headways, depending on the population of other campuses and the distance between them. Distant campuses are often hospitals or research centers. For example, the School of Medicine at the University of California at Davis is located in Sacramento, 17 miles (27.4 km) away. The J. J. Pickle Research Park at the University of Texas at Austin is located 9 miles (14.5 km) away from the main campus. The longer distances between campuses obviously result in longer transit headways.

Multi-nodal Universities

Several sources were used to identify universities with both multi-campus models and innovative TDM programs. Initially, universities identified by organizations that promote campus sustainability (see Appendix B) and those prominently identified in the literature as having innovative TDM programs

were selected. Through this process, 19 universities were selected for further review. Additionally, TCRP Synthesis 78 supplemental data provided by Nelson/Nagaard Consultant Associates [14] was used to identify multi-nodal universities. With these data, six universities were selected as model multi-nodal universities. Two were added as identified in the literature as being multi-nodal. The eight universities selected are:

- Arizona State University (ASU), Tempe, AZ
- Colorado State University (CSU), Fort Collins, CO
- Duke University, Durham, NC
- University of California (UC), Davis, CA
- University of Michigan (UM), Ann Arbor, MI
- University of Texas (UT), Austin, TX
- University of Washington (UW), Seattle, WA
- University of New Mexico (UNM), Albuquerque, NM

These universities are described in detail with data provided primarily from individual university websites and university-generated reports, including master plans. Because it is the primary focus of this study, the UNM campus is described separately in Section 5.

Overview of Selected Universities

Initial tables and figures provide snapshots of the sustainability efforts and TDM programs of the individual campuses as well as inter-campus comparisons; the case studies for the eight universities provide additional information for each. Findings, observations, and conclusions reached by examining each the universities complete the section.

Highlighted characteristics include:

- City and University Statistics (Table 4-1)
- Multi-Nodal Campus Structure and Transit Operators (Table 4-2)
- Transit Modal Split: Students and Employees (Figure 4-1)
- Multi-Nodal University Modal Splits for Students and Employees (Table 4-3)
- Elements of Alternative Transportation Programs (Table 4-4)
- Transportation Summaries: College Sustainability Report Card (Table 4-5)

Table 4-1

City and University Statistics

University	City	City Population	City Type	Total Enrollment	Full Time Enrollment	Part Time Enrollment
ASU	Tempe, AZ	161,719	Urban	68,064	54,626	13,448
CSU	Fort Collins, CO	143,986	Suburban	28,659	25,413	3,246
Duke	Durham, NC	228,330	Suburban	14,662	13,662	1,000
UC Davis	Davis, CA	65,622	Rural	32,153	30,710	1,443
UM	Ann Arbor, MI	283,904	Urban	41,042	38,096	2,946
UNM	Albuquerque, NM	907,755	Urban	28,757	20,479	8,278
UT Austin	Austin, TX	790,390	Urban	50,995	46,111	4,884
UW	Seattle, WA	608,660	Urban	51,150	42,704	8,446

Sources: References 33 and 38

The level of transit required by a multiple-campus university depends upon the activities at the different campuses, the population of each campus, and the distance between campuses. Table 4-2 details these characteristics and provides information about transit service providers.

Figure 4-1 displays the transit modal split of students and employees (faculty and staff) at these eight universities. The utilization of transit at these universities varies significantly for both students and employees.

Clearly, students use transit at a consistently higher rate than employees. At Duke, students use transit significantly more than employees; its 39 percent on-campus housing rate and 30 routes may be a significant factor in its high utilization by students.

Table 4-3 shows the modal split for single occupancy vehicles and four other alternative transportation modes (bicycle, car/vanpools, public transit, walking). These data were obtained through individual university reports and References [33] and [39]. (Details about sustainability-rating organizations can be found in Appendix B). Data were self-reported and may not be comparable from institution to institution. However, these data can provide perspectives on the relative differences between universities.

Table 4-2

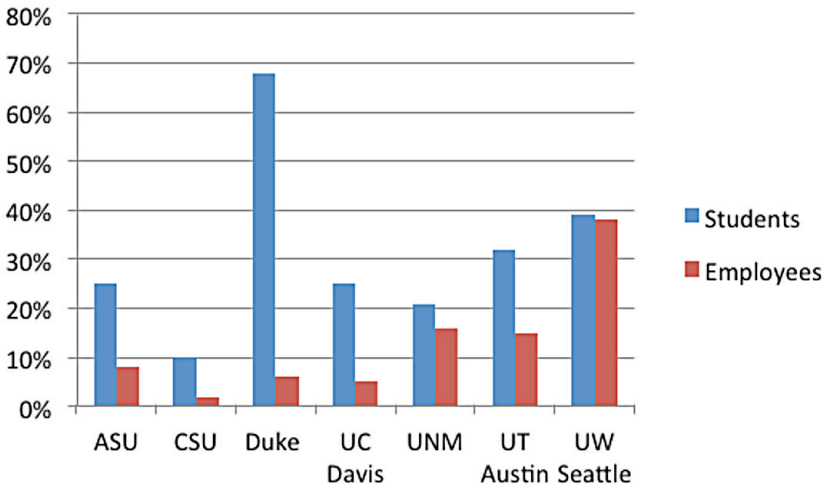
Multi-Nodal Campuses and Transit Operators

University	Campuses	Transit Operators
ASU	4 campuses, the furthest being 48 miles (77.2 km) from each other: Downtown Phoenix, Tempe, Polytechnic, West	Free shuttle (FLASH) between campuses operated with GPS; McAllister shuttle around campus; U-Pass Valley Metro Service & Metro Light Rail.
CSU	3 campus areas less than two miles (3.2 km) apart: Central, East, West	Lory Transit Center; Transfort runs 18 shuttles including CSU routes
Duke	3 campuses: Main, East, Medical, all located within Durham	Duke University Transit operates 30 routes between campuses; Duke Van Service (Medical Center only); GoPass for local and regional transit; Bull City Connector free to Durham
UC Davis	2 campuses: UCD Med Center in Sacramento is 17 miles (27.4km) from main campus in Davis	Rides on Unitrans (student operated) in town free to undergrads; others partially subsidized by University; intercampus Med-Transit shuttle between Main Campus and Medical Center; discounted transit passes for Sacramento Regional Transit, YoloBus, and Solano Transit
UM	4 campuses within Ann Arbor: North, Central, Medical, South	U-M buses free to campuses; AVL Magic buses; Ann Arbor Transportation Authority
UNM	3 campuses in Albuquerque 1 mile (1.6 km) apart; Rio Rancho campus 18 miles away	LOBO shuttles to Main & South campuses; UNM Hospital operates own system; ABQ Ride free; no shuttle to Rio Rancho
UT Austin	2 campuses, 9 miles (14.5 km) apart: Main Campus, Pickle Research Center	UT Shuttle (largest in country with 7.5M rides; free; shuttles also provided to high-population areas
UW Seattle	Seattle and Tacoma campuses are 33 miles (53.1 km) apart; Bothell and Seattle are 20 miles (32.2 km) apart	U-Pass for 6 Central Puget Sound transit agencies (OneWayBus tracking available); Sounder Commuter Rail

Sources: Reference 33; University websites on transportation

Figure 4-1

Student and Employee Transit Modal Split



Michigan student data not available.
Source: Reference 33

Table 4-3

Multi-Nodal University Modal Splits for Students and Employees

University	% Campus Housing	Students						Employees					
		SOV	Other Modes	Bicycle	Carpool/ Vanpool	Public Transit	Walk	SOV	Other Modes	Bicycle	Carpool/ Vanpool	Public Transit	Walk
ASU-Tempe	20%	49%	46%	5%	8%	25%	8%	74%	22%	3%	9%	8%	2%
CSU	22%	39%	61%	32%	4%	10%	15%	63%	37%	22%	10%	2%	3%
Duke	39%	28%	72%	0.5%[1]	3%	68%	0.5%[1]	69%	31%	7.5%[1]	10%	6%	7.5%[1]
UC Davis	15%	16%	84%	45%	6%	25%	8%	56%	44%	22%	13%	5%	4%
UM	40%	n/a	n/a	n/a	n/a	n/a	n/a	55%	45%	1%	8%	34%	2%
UNM	11%	49%	51%	11%	10%	21%	9%	59%	41%	9%	10%	16%	6%
UT Austin	15%	36%	64%	13.8%[1]	5%	32%	13.8%[1]	68%	32%	3%[1]	11%	15%	3%[1]
UW Seattle	23%	12%	87%	9%	3%	39%	36%	38%	59%	7%	10%	38%	4%

[1]In the STARS ratings, the bike and walking modal choices are combined. They have been split 50/50 for this report.

Table 4-4 displays three alternative transportation programs (transit, bicycle, vehicle-related) and the various elements used to promote their use at each of the eight universities; Duke has 12 of the 13 elements on its campus. Carpool matching websites, carshare programs, and Guaranteed Ride Home programs are available at all eight universities. Market-based parking rates and preferred parking for low-emitting/fuel-efficient vehicles appear to be the least-used programs. Recently, CSU opened a new parking structure and has implemented a LEED (Leadership in Energy and Environmental Design) parking permit program for alternative-fueled and hybrid vehicles.

Table 4-4

Elements of Alternative Transportation Programs

Profile Area	ASU	CSU	Duke	UC Davis	UM	UNM	UT Austin	UW Seattle
Transit								
Free Shuttle	x	x	x	x	x	x	x	x
Unlimited Access	x	x	x	x	x	x	x	x
Discounted passes			x	x				
Bicycles								
Bike-share	x	x	x	x		x	x	
Bike rent	x	x	x	x		x	x	x
Vehicles								
Marketed-based pricing (hourly parking costs)	x			x				x
Car-share	x	x	x	x	x	x	x	x
Carpool matching website	x	x	x	x	x	x	x	x
Carpool parking	x	x	x	x	x		x	x
Vanpool parking	x	x	x	x	x		x	x
Guaranteed Ride Home	x	x	x	x	x	x	x	x
Preferred parking for carpools/vanpools	x	x	x	x	x		x	x
Preferred parking for low-emitting/fuel-efficient vehicles	x	x		x				

Sources: References 33 and 39; University transportation websites

Table 4-5 summarizes each university's transportation, transit, and alternative transportation programs, as reported in Reference [33].

Table 4-5

Multi-Nodal Campuses Transit and Alternative Transportation Programs

University	CSRC Grade	Transportation Category Summary
ASU	A	More than half of all students commute to campus via alternative transportation methods. ASU offers preferred parking, ride-matching to carpoolers, provides discounts on public transportation, operates shuttle around/between campuses. ASU runs a bike-sharing program/repair service, partners with car-sharing program. Campus motor fleet includes electric, hybrid, ethanol, and compressed natural gas vehicles.
CSU	B+	Students ride local buses for free; bike-sharing program available to students at no cost. CSU provides ride-matching website, employees who carpool receive preferred parking. More than 60% of commuter students travel to campus via environmentally-preferable methods. Parking lots being moved to periphery of campus to encourage walking/biking.
Duke	A	Duke provides on-line services-matching service to coordinate carpooling, offers preferred/discounted parking for high occupancy vehicles, provides free transportation around campus and to downtown Durham, provides free bike-sharing program with 120 bikes available.
UC Davis	A	UC Davis offers ride-matching services, preferable parking to carpoolers; all campus community members receive discounts on local public transit; provides shuttle services to other campuses/local attractions. Bike Barn provides rentals/repairs; car-sharing program available. University administration in process of increasing accessibility for pedestrians.
UM	B	UM fleet includes 655 alternative-fuel vehicles. M-Ride program enables all students/employees to ride local transit buses for free anywhere in Ann Arbor area. Car-Sharing program featuring 10 vehicles helps reduce traffic on campus.
UNM	B	UNM's fleet includes at least 84 alternative-fuel vehicles. UNM offers a free ride-matching service, provides preferable parking for fuel-efficient vehicles. Free passes for Albuquerque bus system available to all students, faculty, staff. UNM runs bike-sharing program and partners with car-sharing program.
UT Austin	A	Half of school community travels to campus via alternative modes of transportation, university offers carpool incentives and free access to public transportation to students and staff. UT Austin operates shuttles to high-population residential areas, runs bike-sharing program, is working to make campus more pedestrian-friendly. Majority of vehicles in campus motor fleet run on alternative fuels.
UW Seattle	A	All campus community members participating in U-PASS program receive unlimited public transit passes, discounts on carpool permits and car-sharing program. Student government runs nonprofit bike repair shop, 88% of students and 62% of employees commute via environmentally-preferable means.

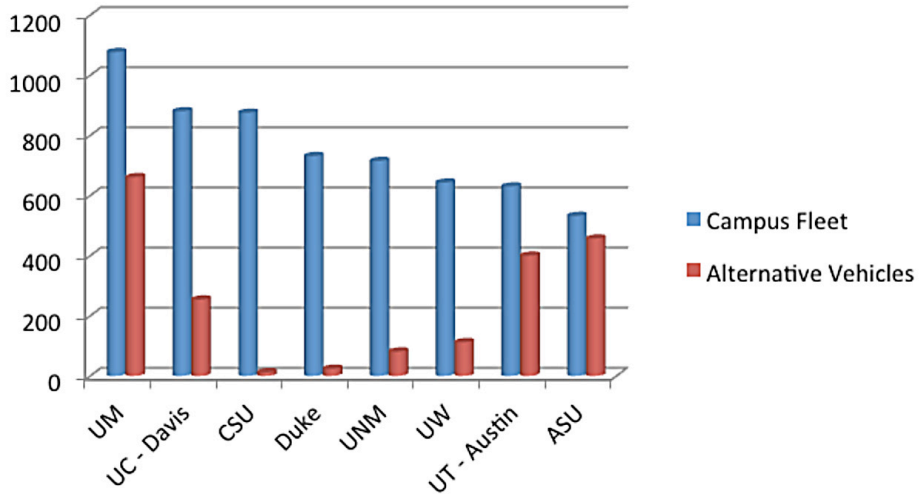
Source: College Sustainability Report Card (CSRC), Reference 33

Use of Alternative Fuels and Hybrid Vehicles

University sustainability programs also reduce carbon emissions by using green fuels and hybrid university-owned vehicles. Figure 4-2 summarizes the use of alternative fuels and hybrid vehicles by the universities.

Figure 4-2

Use of Alternative Fuels and Hybrid Vehicles



Source: Reference 33

Table 4-6 details the type of fuels and vehicles that are used by each university. An impressive 86 percent of ASU vehicles use alternative fuels or are hybrid vehicles. One-half of its vehicles are 100 percent electric. On the other hand, UM has the largest number of alternative-fueled and hybrid vehicles; of its campus fleet of 1,077 vehicles, 661 are alternative-fueled and hybrid vehicles.

Table 4-6

Campus Fleets and Use of Alternative Fuels and Hybrid Vehicles

	ASU	CSU	Duke	UC Davis	UM	UNM	UT Austin	UW
Total campus motor fleet	532	875	731	880	1,077	715	630	643
100% electric	267	10	19	29	6	40	105	4
Fueled with B20 or higher for more than 6 mo	3	0	0	78	96	23	48	46
Fueled with E85 or higher biofuel for more than 6 mo	0	0	0	0	545	0	107	0
Gasoline-electric hybrid	8	2	5	56	14	1	3	59
CNG/E85/LPG	179	0	0	0	0	17	0	0
Propane capable (LNG)	0	0	0	0	0	0	137	0
Total alternative-fuel vehicles	457	12	24	254	661	82	400	112

Source: Reference 33

University Case Studies

Case studies have been developed primarily using data from individual university websites for each of the eight multi-nodal universities identified in this section. These studies include information about each university's transportation program as well as sample Web pages and graphics used in marketing these programs. The common elements in these studies are:

- Description of Multi-Nodal Campus Setting
- Transportation Highlights
- Sustainability Ratings
- Local Transportation Alternatives
- Transit
- Bicycles
- Modal Split for Students and Employees
- Campus Motor Fleet

These eight universities represent a wide range of characteristics and settings, which include:

- City types: urban, suburban, rural
- City populations: 65,000–910,000
- University enrollment: 15,000–68,000
- Number of campuses: 2–4
- Distance between campuses: 1 mile (1.6 km) to 48 miles (77.2 km)
- Use of alternative transportation: students: 46–87%
- Employees: 22–59%
- Student on-campus housing: 11–40%
- Use of alternative fuels: 1.3–86% of campus fleet

The diversity of university characteristics and settings provides information on a wide range of alternative transportation programs. Findings, observations, and conclusions from these studies are found at the end of the section. The UNM case study is presented in Section 5.

Arizona State University (ASU)

ASU as a Multi-Nodal University

ASU is spatially-distributed across metropolitan Phoenix in four different locations. Unlike most multi-campus institutions, ASU describes itself as "one university in many places," meaning that it is not a university system with separate campuses and not one main campus with branch campuses.

Each campus represents a planned clustering of related colleges and schools, with the farthest campus 48 miles (77.2 km) from another. The four campuses are Downtown Phoenix, Tempe, Polytechnic, and West Campus. Tempe is the site for all of ASU's athletic facilities.

Inter-campus shuttles and light rail allow students and faculty to travel between the campuses. Valley METRO light rail has stations at the Tempe and downtown

Phoenix campuses. There are also reciprocal designated parking spaces for students traveling from other campuses. Each campus is responsible for managing its transportation activities, including parking.

ASU is in an urban setting with a student enrollment of 68,064, including 54,626 full-time and 13,438 part-time students. On-campus student housing at the Tempe campus is about 20 percent of the student population.

Transportation Highlights

- The Campus Master Plan calls for a reduction of 5,000 vehicles over 5 years (35,000 cars come to the Tempe campus daily).
- A carbon-neutral goal has been established for 2035 for transportation.
- Each campus is responsible for parking management, the hourly shuttles to each campus, and reciprocal parking spaces for each campus.
- The University received an "A" rating by the College Sustainability Report Card.
- Intercampus shuttles are equipped with GPS.
- A light rail system opened in 2008 and links the Tempe and Downtown Phoenix campuses.
- The University promotes a "Don't Drive One-in-Five Contest" to recognize persons using various forms of alternative transportation.
- A total of 41% of students work off campus.
- Parking and Transit Services does not financially benefit from event parking (1,600 events per year)
- A total of 86% of the campus fleet uses alternative energy, primarily 100% electric vehicles.
- A USG Community Bikes Program offers free bikes for up to two weeks at a time.
- The ASU Parking and Transit Manual and all forms are on-line, as are the planning documents summarized in Table 4-7.

Planning Documents and Transportation Websites

Various ASU planning document websites are listed in Table 4-17.

Table 4-7

Planning Documents and Transportation Websites, ASU

Area	Document	Resource
Campus Master/ Strategic Plan	Comprehensive Development Plan for a New American University (2006); + action plan done every two years	http://www.asu.edu/purchasing/forms/asu_exec_sum_compplan.pdf
Transportation Master Plan	Parking and Transit Task Force Comprehensive Transportation Plan: City of Tempe (2008)	http://cfo.asu.edu/pts-taskforce-report http://www.tempe.gov/tim/PDFs/CompTranPlanMarch2008.pdf
Sustainability	Strategic Plan for Practices and Operations	http://sustainability.asu.edu/about/resources/sustainabilityplan/
Transportation Goals	Carbon-neutrality Action Plan (2010) "By 2035, ASU will mitigate carbon emissions from transportation by 100 percent."	http://carbonzero.asu.edu/CarbonPlan022410.pdf
Transportation Website	ASU Parking and Transit Services	http://cfo.asu.edu/pts

Sustainability Ratings

According to the 2011 College Sustainability Report Card (CSRC) [33], ASU received an "A" for its sustainable transportation efforts.

> Over half of all students commute to campus via alternative transportation methods. The university offers preferred parking and ride-matching to carpoolers, provides discounts on public transportation, and operates a shuttle around and between campuses. ASU runs a bike-sharing program and repair service and also partners with a Car-Sharing program. The campus motor fleet includes electric, hybrid, ethanol, and compressed natural gas vehicles. (http://www.greenreportcard.org/report-card-2011/schools/arizona-state-university-tempe)

In addition, ASU received the Green Honor Roll recognition by the Princeton Review of Green Colleges. Only 99 universities received a "green" recognition, and only 19 of those universities were named to the Green Honor Roll (http://www.princetonreview.com/uploadedFiles/Sitemap/Home_Page/Green_Guide/PrincetonReview_GreenGuide_2011.pdf).

Local Transportation Alternatives

ASU Parking and Transit Services' commuter options program provides a number of sustainable transit options for the ASU community, many of which are free or subsidized for users. The alternative transportation programs include the U-Pass, which provides discounted bus and light rail passes to students and the faculty, and a partnership with the car-sharing company Zipcar, which encourages the use of public transportation for daily commutes to campus. In addition, the Undergraduate Student Government's Bike Co-op, a community bike program on the Tempe and Polytechnic campuses, allows

students, faculty members, and staff to check out bicycles for up to 10 days at no charge. The Co-op also provides low- or no-cost repairs and reduced cost helmets and locks. This program has increased bicycle use for travel to, from, and around campus.

ASU U-Pass

The U-Pass for students, faculty, and staff provides unlimited public transportation to and from all four ASU campuses and throughout the Phoenix area via the Valley Metro bus and Metro Light Rail systems. Metro Light Rail has stations in Tempe and Downtown Phoenix.

ASU's Parking and Transportation Services subsidizes a portion of the student passes; students pay $40 per semester or $80 for the academic year. This saves students between $310 and $440 annually over the discounted rate offered to the faculty and staff. In spring 2007, the University distributed 14,000 U-Passes, eliminating as much as 176 tons of pollution and saving more than $1 million in fuel costs for the year. ASU operates FLASH, a free shuttle, to each of its four campuses and the McAllister shuttle for the Tempe campus. Table 4-8 is a profile of transit services at ASU.

Table 4-8
Transit Profile, ASU

U-PASS	Subsidized by ASU, offers unlimited rides on area buses and light rail; light rail started 2008. Student subsidy: 90%; Employee subsidy: 45%
University Shuttle	FLASH – three free shuttles between campuses not on light rail operate with GPS; Orbit – City of Tempe operates the free Orbit shuttles; McAllister shuttle around Tempe campus
Transit Operator	U-Pass Valley Metro Service & Metro Light Rail

Intercampus Transit Tracking

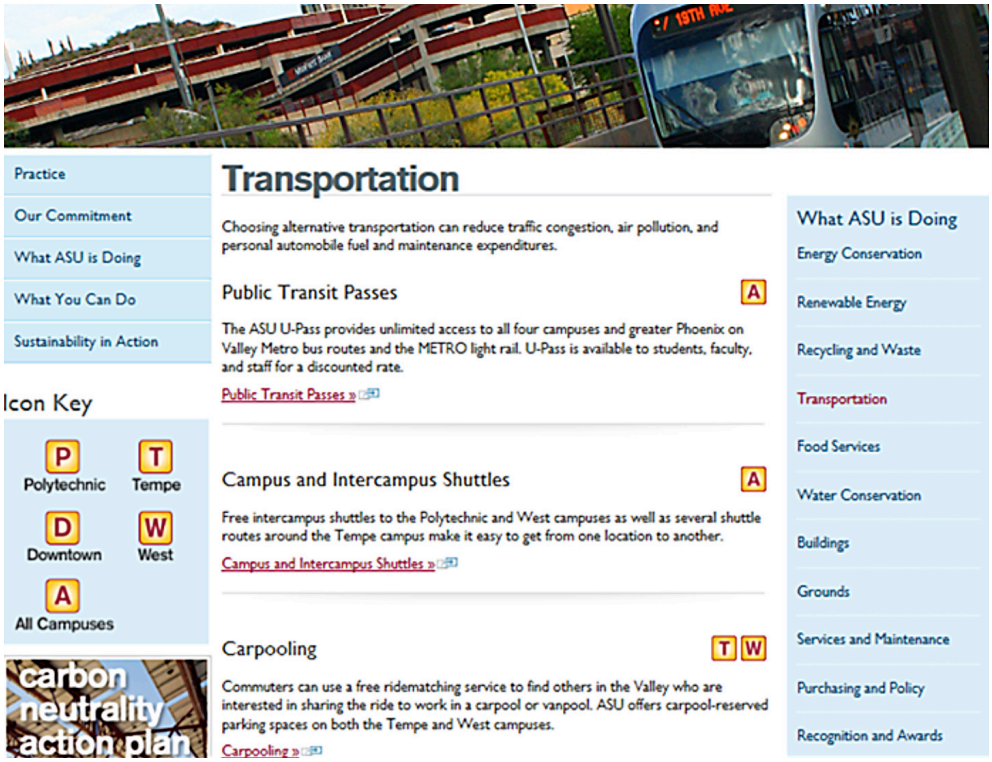
Real-time tracking of the intercampus shuttles as they travel between ASU's four campuses is called Sun Devil Transportation Activity in Real Time, START. The online tracking system follows the GPS-equipped buses to allow riders to see where they are at all times on a computer or smart phone (www.asustarthere.com). Transit maps for inter-campus shuttles can be easily found by using the icon keys on the Transportation website shown in Figure 4-3.

Parking and Transit Portal

ASU's Parking/Transit website portal, shown in Figure 4-4, is easy to navigate and comprehensive for University users.

Figure 4-3

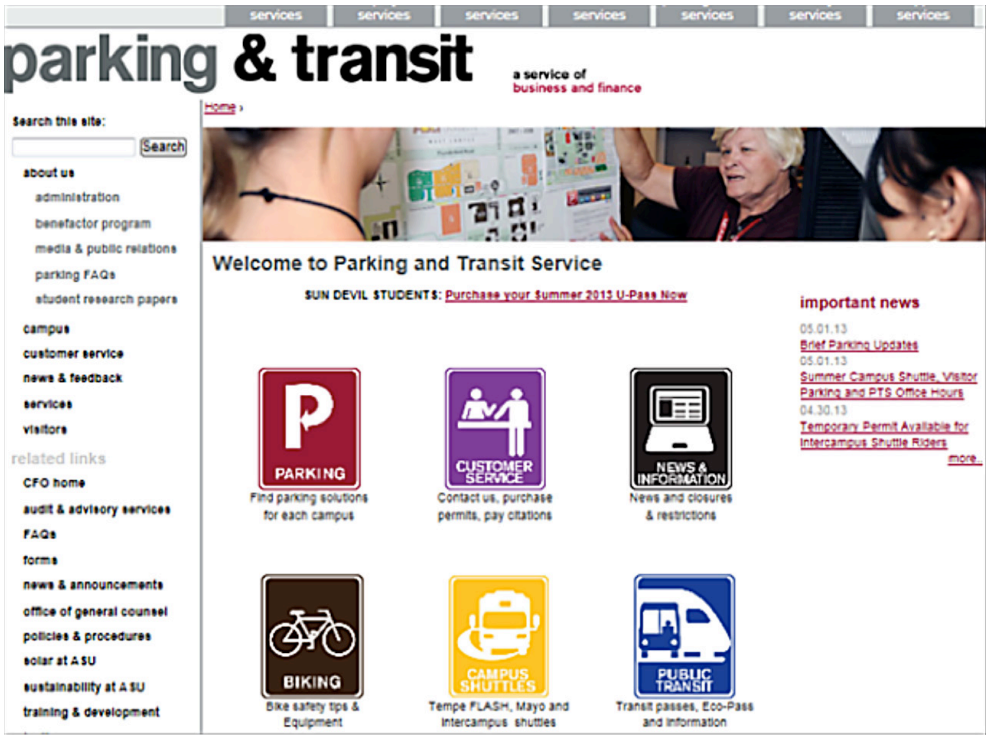
ASU Transportation Services Webpage



Source: http://sustainability.asu.edu/practice/what-asu-is-doing/transportation.php

Figure 4-4

ASU Portal for Alternative Transportation and Interconnecting Shuttles



Source: http://cfo.asu.edu/pts-commuter-shuttle

Bicycling/Carpooling at ASU

Biking represents a sustainable alternative to personal vehicle use and is a practical and environmentally-friendly transportation option. The Bike Co-op provides reduced-cost tools, parts (both new and used), and bicycle repair assistance. It also houses the USG Community bikes program, an initiative that allows ASU students, faculty members, and staff to check out one of 15 bikes. The Bike Co-op website is http://src.asu.edu/Bike.

Each Parking and Transit Services webpage for biking or carpooling has tabs for each of the four campuses, making alternative transportation at each campus readily available. Summary data for both bicycle and carpooling programs are shown in Tables 4-9 and 4-10.

Table 4-9
Bicycling and Car-Sharing, ASU

Area	Bicycling and Car Sharing		Car Sharing Program
	Sharing/ Rentals	*Bicycle Repair Services*	
Bicycle sharing/rentals	Yes	Bike co-op	Zipcar
Year created	1999		2007
Number of bikes available	30		17 vehicles, w/3 hybrid
Usage fee per hr/day	$0/$0		$8/hr, $66/day
Service fee		Parts, repairs	
Annual fee			$35

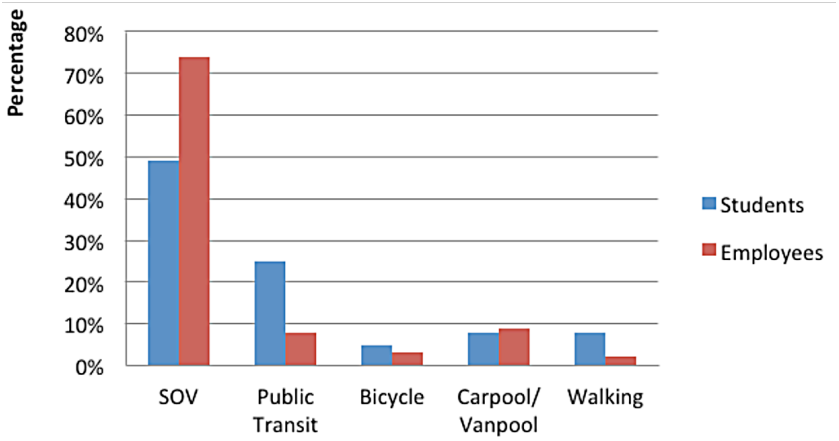
Table 4-10
Carpooling, ASU

Carpooling incentives: students	Students: Yes Staff: Yes
Carpool matching	Register @ RideShare.com
Ride matching	ShareTheRide.com
Preferential parking	Yes

ASU Modal Split for Students and Employees

In general, students make more use of alternative transportation modes than employees. Only 26 percent of employees use alternative transportation modes; 51 percent of students use alternative transportation. Twenty-five percent of students use public transit; this is three times higher than the rate of employee usage. Further breakdowns are shown in Figure 4-5 and Table 4-11.

Figure 4-5
Modal Split, ASU



Source: Reference 33

Table 4-11
Modal Split, ASU

	SOV	Public Transit	Bicycle	Carpool/ Vanpool	Walking
Students	49%	25%	5%	8%	8%
Employees	74%	8%	3%	9%	2%

Source: Reference 33

Campus Motor Fleet

An impressive number of ASU vehicles use alternative fuels or are hybrid vehicles. Fifty percent of ASU vehicles are 100 percent electric, as detailed in Table 4-12.

Table 4-12
Campus Motor Fleet, ASU

Total in campus fleet	532
Type of alternative fuel	
100% electric	267
Fueled with B20 or higher	3
Gasoline-electric hybrid	8
CNG/E85/LPG	179
Total (%) alternative fuel vehicles	*457 (86%)*

Source: Reference 33

Colorado State University

CSU as a Multi-Nodal University

Colorado State University is located in Fort Collins, Colorado, a mid-size city of approximately 142,000 residents. The university's 583-acre Main Campus is located in central Fort Collins; a 101-acre veterinary teaching hospital is on the South Campus. CSU is also home to the 1,438-acre agricultural Foothills Campus. The three campuses are less than two miles (3.2 km) apart; all are served by transit. CSU has a total student enrollment of 28,659, including 25,413 full-time students and 3,246 part-time students. Approximately 20 percent of students live on campus.

Transportation Highlights

- The University's Strategic Directions Plan 2006–2015 is moving toward a more pedestrian-friendly campus by locating parking closer to the edges of campus and encouraging walking and bicycling.
- The Foundations for a New Century Master Plan includes a transportation component, which is updated every 10 years.
- CSU's transportation goal is to be carbon-neutral by 2035.
- A LEED Parking Permit program allocates spaces in new parking structures for hybrid and green cars.
- More than 60% of commuter students use alternative transportation, including 32% of students and 22% of staff using bicycles.
- The Lory Transit Center is LEED Gold-certified and operates RamRide, a free-ride program provided by Associated Students of CSU.
- CSU is the largest user of Transfort, the city transit operator.
- There are 15,000 bicycles on campus daily; the University recently received a Silver Award as a Bicycle Friendly University (BFU) from the League of American Bicyclists.
- Commuter survey results are available on the Sustainability in Facilities Management website (http://fm.colostate.edu/sustain/index.cfm?page=about/reports).
- CSU maintains its Core Campus Access Policy and Safe Cycling Bicycle Regulations on-line.
- Segways are being used under a trial program within the Trades, Grounds, and Maintenance shops in Facilities Management.

Planning Documents and Transportation Websites

Various CSU planning document websites are listed in Table 4-13.

Table 4-13

Planning Documents and Websites, CSU

Area	Document	Resource
Campus Strategic/ Master Plan	Strategic Plan: 2006–2015	http://www.provost.colostate.edu/files/Resources/csu-strategic-plan-update-2006-2015.pdf
	Master Plan Update 2010	http://www.facilities.colostate.edu/files/forms/2010_master_plan_poposed_amendments.pdf
	Campus Master Plan Foundation for the New Future	http://www.facilities.colostate.edu/files/forms/Campus_Master_PlanWEB_SM.pdf
Transportation/Transit Strategic Plan	Transfort Strategic Operating Plan Update 2009	http://www.fcgov.com/transfort/pdf/tsp_executive_summary.pdf
Sustainability	School of Global Environmental Sustainability	http://soges.colostate.edu/sustainability-at-csu/sustainability-csu-overview.html
Transportation Goal	University Master Plan calls for a continuing move towards a more pedestrian-friendly campus. By moving parking closer to edges of campus, CSU aims to encourage alternative modes of transportation on campus, such as walking and bicycling. Transportation goal is to be carbon-neutral by 2035.	
Transportation Website		http://parking.colostate.edu/

Sustainability Ratings

According to the 2011 CSRC [33], CSU received a "B+" for its sustainable transportation efforts.

> Students ride the local buses for free, and a bike-sharing program is available to students at no cost. The college provides a ride-matching website, and employees who carpool receive preferred parking. More than 60 percent of commuter students travel to campus via environmentally-preferable methods. Parking lots are being moved to the periphery of campus to encourage walking and biking. (http://www.greenreportcard.org/report-card-2010/schools/colorado-state-university/surveys/campus-survey)

In addition, CSU was named as one of the top 12 Bicycle Friendly Universities in the country in a ranking by the League of American Bicyclists. CSU received a silver award for its strong commitment to promoting and providing a more bicycle-friendly campus for students, staff and visitors.

Local Transportation Alternatives

Transit

The University's student government association, ASCSU, partners with the City of Fort Collins to provide bus service to the campus community. All CSU students receive a RamCard to ride the Transfort bus systems at no cost. (RamCard also provides access to other CSU services.) ASCSU also operates RamRide, a safe-ride home program that also serves to reduce individual student vehicle usage.

The Lory Transit Center, a LEED Gold-certified building, was opened in 2006. The Center, which is linked to the student center, includes a Transfort customer counter, flat-screen monitors displaying departure times, and news stories and an indoor passenger waiting area for CSU students and visitors.

Transfort operates 18 routes when CSU and public schools are in session and 14 routes when not in session. Fixed-route service is provided Monday through Saturday and generally begins between 6:00–6:30 AM, with the last trip scheduled to depart between 6:30–7:00 PM. Service frequencies range from 20–60 minutes. Transfort owns and maintains 26 standard 40-ft transit buses, 4 mid-sized 35-ft transit buses, and 13 paratransit vehicles as part of its fleet.

System-wide, Transfort had 1.9 million riders in 2008 on its fixed-route system. On average, weekday ridership is 73 percent higher when CSU is in session than when it is out of session. CSU represents 36.7 percent of Transfort's service; 5 percent of

its funding comes from the Associated Students at CSU. The profile is shown below in Table 4-14.

Table 4-14
Transit Profile, CSU

Unlimited Access	CSU subsidizes the RamCard, which offers unlimited rides on Transfort; Student subsidy: 100%; Employee subsidy: 68%
University Shuttle	Core of Main Campus is pedestrian only; Transfort has routes to each campus
Transit Operator	Transfort
On-Campus Transit Center	Lory Transit Center

Bicycling and Carpooling/Vanpooling

The League of American Bicyclists selected CSU as one of 12 Bicycle Friendly Universities. Nearly 15,000 bicycles are used by students and employees daily. The Main Campus has nearly 3 miles (4.8 km) of bicycle pathways, and the University offers a full range of bicycle support services. All bikes must be registered with the University Police department at a cost of $5. The services are summarized in Table 4-15.

Table 4-15
Bicycling and Car-Sharing, CSU

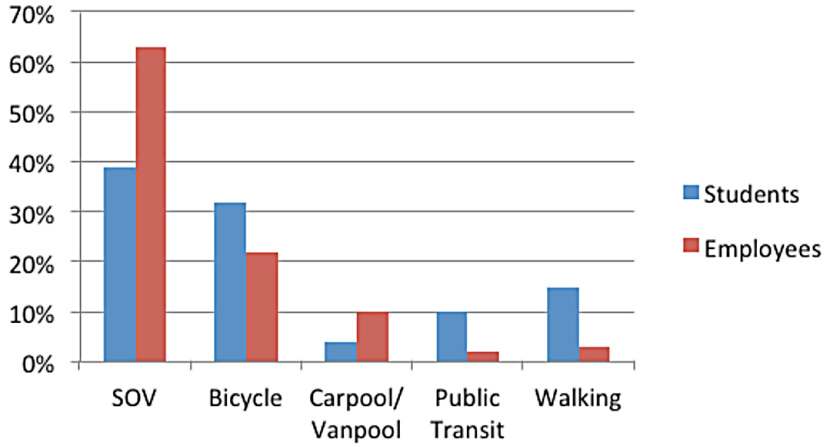
Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rentals	Yes	Yes	Zipcar
Year created	2004		2011
Number available	11		Unknown
Usage fee per hr/day	$0/$0		$8/hr; $66/day
Service fee		Fees charged as service is privately-owned	
Annual fee			$35
Membership fee	$0		
Other	Safe Cycling Bicycle Regulations, http://police.colostate.edu/pdfs/Bike-Booklet.pdf		

CSU participates in northern Colorado's "Get on the Go" commuter services for alternative transportation. CSU students and employees can register through Rideshare.com (https://www.smarttrips.org/Pages/carpool).

CSU Modal Split for Students and Employees

In general, students use more alternative transportation modes than employees. Only 37 percent of employees use alternative transportation; 61 percent of students use alternative transportation. Bicycling is commonly used, with 32 percent of students and 22 percent of staff using the mode. A more detailed breakdown is shown in the Figure 4-6 and Table 4-16.

Figure 4-6
Modal Split, CSU



Source: Reference 33

Table 4-16
Modal Split, CSU

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	39%	32%	4%	10%	15%
Employees	63%	22%	10%	2%	3%

Source: Reference 33

Campus Motor Fleet

Table 4-17 shows CSU's use of alternative fuels and hybrid vehicles.

Table 4-17
Campus Motor Fleet, CSU

Total campus motor fleet	875
Type of Alternative Fuel	
100% electric	10
Gasoline-electric hybrid	2
Total (%) alternative fuel vehicles	*12 (1.4%)*

Source: Reference 33

Segway Use

Segways are being used on a trial basis within the Trades, Grounds, and Maintenance shops of the Facilities Management Department. The Segway provides a more efficient means of transportation for on-campus errands than adding an additional vehicle to the fleet. In addition, the cargo boxes make the Segway more functional. On the green side, the battery-operated Segway means this transport mode gives off zero emissions during operation, reducing GHG emissions and use of fossil fuels.

Duke University

Duke as a Multi-Nodal University

Duke University is located in suburban Durham, North Carolina, which has a population of 228,330. Duke has a student enrollment of 14,662, including 13,662 full-time and only 1,000 part-time students. Convenient on-campus housing has resulted in 39 percent of students living on-campus. Duke has four campuses: Central, East, West, and Medical. The Duke Medical School is located one mile from the Central Campus. West Campus, the heart of Duke University, houses all the sophomores, along with some juniors and seniors. In addition, most of the academic and administrative centers are located there. Main West Campus contains the majority of residential quads to the south, while the main academic quad, library, and Medical Center are to the north. This campus, spanning 720 acres, includes Science Drive, which consists of science and engineering buildings. Most of the campus eateries and sports facilities, including the historic basketball stadium, Cameron Indoor Stadium, are on West.

East Campus, the original location of Duke after it moved to Durham, functions as a freshman campus as well as the home of several academic departments. This campus encompasses 97 acres and is 1.5 miles (2.4 km) away from West Campus. East Campus, a fully self-sufficient campus, contains the freshman residence halls, a dining hall, coffee shop, post office, Lilly Library, Baldwin Auditorium, a theater, Brodie Gym, tennis courts, and several academic buildings. Downtown Durham is just a short walk away.

Central Campus, consisting of 122 acres between the East and West campuses, houses around 850 juniors and seniors and 200 professional students in apartments. It is home to the Nasher Museum of Art, the Freeman Center for Jewish Life, the Duke Police Department, the Duke Office of Disability Management, a Ronald McDonald House, and administrative departments such as Duke Residence Life and Housing Services.

Transportation Highlights

- A Strategic Plan was published in 2006, and the Duke Physical Campus Plan came out in 2000. Both were updated in 2010.
- Duke's transportation goal is to be carbon-neutral by 2024.
- Duke's Transportation Policy is "Walkable campus supported by understandable circulation system; Duke is a community of communities."
- Duke is the highest ranking university in sustainability rankings (Sustainability Report Card = A-; STARS = Gold).
- An impressive 72% of students use alternative transportation; 68% of these are by public transit.
- Duke provides up to a 60% discount on city bus passes for students and employees.

- Duke operates 30 buses on 12 routes to the 4 campuses and some neighboring areas.
- The Robertson Scholar bus takes students between Duke and Chapel Hill for free.
- YouTube videos are available for each mode of alternative transportation; there is a monthly YouTube newsletter on alternative transportation.
- Parking accounts can be managed on-line through Managing My Parking Account to update vehicle information, check or revise waitlist status, view permits, and pay or appeal citations.
- Duke Vans provides on-demand, free transportation to employees and students in specified service areas where Duke Transit buses are not available. The vans offer an alternative to walking alone or in isolated areas of campus from dawn to dusk.

Planning Documents and Transportation Websites

The various campus planning documents are shown in Table 4-18.

Table 4-18

Campus Planning Documents and Transportation Websites, Duke University

Area	Document	Resources
Campus Master/ Strategic Plan	Duke Physical Campus Plan 2000 with updates including 2010 Strategic Plan–Making a Difference: A New Model of Education (Collaboration and Connection)	http://www.architect.duke.edu/planning/master_plan.html http://stratplan.duke.edu/
Transportation Strategic Plan	Could not locate	
Transportation Goal	Carbon-neutral by 2024; walkable campus supported understandable circulation system	
Transportation websites	Parking and Transportation Services Parking Policies and Regulations (2009-2010)	http://parking.duke.edu http://parking.duke.edu/forms_apps/Duke%20University%20Parking%20Policies%202009-20101.pdf

Sustainability Ratings

According to the 2011 CSRC [33], Duke University received an "A-" for its sustainable transportation efforts.

> Duke provides on-line services-matching service to coordinate carpooling, and offers preferred and discounted parking for high occupancy vehicles. The university provides free transportation around campus and to downtown Durham, and a free bike-sharing program with 120 bikes is available. (http://www.greenreportcard.org/report-card-2011/schools/duke-university)

Duke was one of only 23 universities that received the STARS Gold Award in recognition of the university's sustainability efforts. STARS is a self-reporting framework for universities to gauge relative progress towards sustainability.

Sustainability Initiatives

With more than 30,000 employees, thousands of students, and tens of thousands of visitors, Duke University and Health System generates significant demand for transportation. Duke is striving to increase the convenience and incentives for commuters using alternative modes of transportation to achieve carbon-neutrality, preserve green space, and prevent congestion. Duke uses a number of logos in support of branding its sustainability initiatives, including a site on which an individual can use a carbon calculator.

Local Transportation Alternatives

Transit

The transit profile at Duke is summarized in Table 4-19.

Table 4-19
Transit Profile, Duke

Transit Subsidy	Students and employees subsidized up to 60%
University Shuttle	Duke Transit; Bull City Connector
Transit Operators	GoPass allows for unlimited rides on DATA, Triangle Transit, Capital Area Transit and C-Tran

Duke Transit operates more than 30 buses on more than a dozen routes serving the East, West, Central, and Hospital campuses in addition to some neighboring areas. The Robertson Scholar bus takes students between Duke and Chapel Hill for free, and one of the free Duke Transportation buses serves downtown entertainment destinations in the evenings. Duke has a user-friendly smart phone program that allows community members to easily check bus schedules.

The University also provides up to a 60 percent discount on City bus passes for faculty, staff, and students. Employees who join the automatic renewal program for 31-day bus passes and choose payroll deduction or Bursar billing receive additional savings.

Duke offers GoPass, a free local and regional bus pass, to Duke staff and faculty whose offices are on or within ½ mile of the East, West, Central and Medical

Center campuses or the American Tobacco Campus. GoPass allows for unlimited rides on Durham Area Transit Authority (DATA), Triangle Transit, Capital Area Transit, and C-Tran, the town of Cary's transit service, at no charge. The Bull City Connector is a fare-free, hybrid-electric bus service that connects downtown Durham with the Duke University campus and medical facilities. Under an agreement between Duke and the City of Durham, Duke provided $375,000 so Durham could receive a $3 million federal grant and a $375,000 state grant to buy new hybrid-diesel buses. Duke will also contribute toward annual operating costs of the service. The new buses debuted on the route in 2012. In the meantime, the City is using four existing 2010 model hybrid buses. Duke also contributes toward annual operating costs, and the City and Triangle Transit manage and operate the service.

Duke Vans

Duke's fleet of vans provides free transportation to employees and students in specified service areas where Duke Transit buses are not available. The vans offer an alternative to walking alone or in isolated areas of campus. Duke also provides on-demand van transportation from dusk to dawn for Duke students, faculty, and employees.

Bicycling and Car-Sharing

Bicycling and car-sharing at Duke are summarized in Table 4-20.

Table 4-20
Bicycling and Car-Sharing, Duke

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rentals	Duke Bikes	Yes	WeCar
Year created	1971		2008
Number available	130+		6 (2 are hybrids)
Usage fee per hr/day	$0		$8/day
Service fee	None; Duke ID	Yes; privately-owned	
Annual fee	$0		
Membership fee			$35
Other	Regulations: http://bikeduke.com/the-routes/bicycle-laws-in-nc/		

Employees and graduate students can register as a bicycle commuter to receive 24 free daily parking permits for days they need to drive a car to campus. Registered Duke bike commuters can use showers in the Wilson Center or Brodie Center. Other bicycling services and resources include:

- Duke Bikes, a bike-loan program that provides bicycles at no cost to students for exercise, adventure, and campus commuting, has a fleet of more than 130 bikes. Students can reserve a bike on-line or at the centrally-located bike shop. The program's average usage is 100 bikes a day.
- Bike repairs and tune-ups can be made at the Outpost on West Campus. Labor is free, and parts are available at cost.
- BikeDuke.com, a website managed by several bike enthusiasts at Duke, provides maps, videos, and information about riding at Duke and around Durham.

Carpooling/Vanpooling

Carpooling and vanpooling at Duke are summarized in Table 4-21.

Table 4-21
Carpooling and Vanpooling, Duke

Carpooling/vanpooling incentives	Students: Yes; Staff: Yes
Carpool/vanpool matching	Register @ GreenRide
Ride matching	Duke GreenRide
Preferential parking	Given special parking permits

Modal Split for Students and Employees

In general, students use more alternative transportation modes than employees. Duke has 39 percent of its student housed on campus, which is a significant factor in the 72 percent utilization of alternative transportation. A total of 68 percent of students use transit, and 31 percent of employees use alternative transportation. Further breakdowns are shown in Figure 4-7 and Table 4-22.

Figure 4-7
Modal Split, Duke

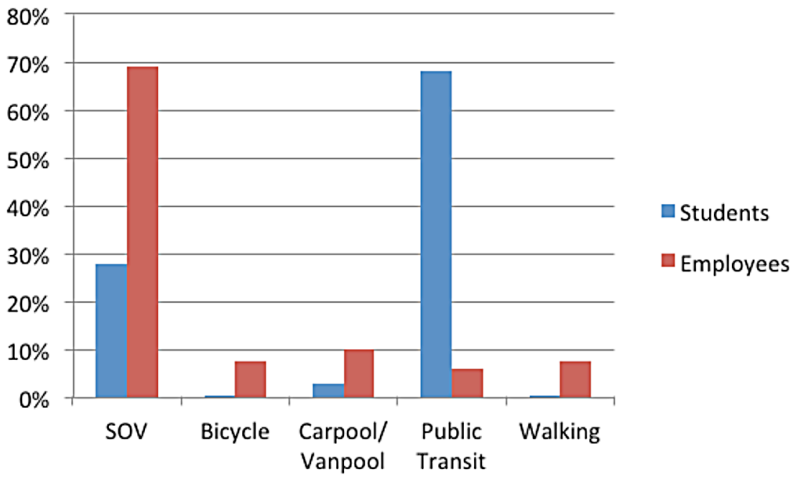


Table 4-22
Modal Split, Duke

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	28%	0.50%	3%	68%	0.50%
Employees	69%	7.50%	10%	6%	7.50%

Source: Reference 33

Campus Motor Fleet

The utilization of alternative fuels in Duke's campus motor fleet is summarized in Table 4-23.

Table 4-23
Campus Fleet, Duke

Total campus motor fleet	731
Type of alternative fuel	
100% electric	19
Gasoline-electric hybrid	5
Total (%) alternative fuel vehicles	*24 (3%)*

Source: Reference 33

University of California at Davis (UC Davis)

UC Davis as a Multi-Nodal University

Davis has a population of 65,622, and the University has a student population of 32,153, including 30,710 full-time students and 1,413 part-time students. In 1991, UC Davis and the City completed a joint transportation system management plan to reduce dependence on SOVs. This collaborative effort has resulted in a transportation management system that has successfully promoted alternative transportation programs at the university.

UC Davis has two campuses. The UC Davis Medical Center is in Sacramento, 17 (27.4 km) miles from the Main Campus in Davis. The Main Campus is the most developed area of the Davis campuses and has a well-defined system of pedestrian walks; several areas in the heart of the campus are designated for pedestrians and bicycles only.

Campus Planning is leading a special initiative to build a mixed-use residential community on campus; West Village will have on-campus housing for more than 4,000 faculty, staff, and students and will have a village green with a strong bus and bike connection to the heart of campus.

Approximately 84 percent of students currently live on campus or in the city of Davis.

Transportation Highlights

- UC Davis refers to its alternative transportation programs as part of its transportation systems management program to make efficient use of existing transportation infrastructure and resources. The campus

circulation system reflects the high level of integration of its program. The 84% usage of alternative transportation by students reflects the success of these efforts. Forty-five percent of students use bicycles.

- The Long Range Development Plan (2003–2015) and a Neighborhood Development Plan reflect close planning collaboration with the City.
- The core campus (an area of 1 × 1.5 miles [1.6 × 2.4 km]) is closed to vehicles; previously-used roadways are now broad pathways for pedestrians and bicycles.
- The University of California Interactive Sustainability Map includes locations for bike services, EV charging stations, transit, and Zipcars; it can be viewed at http://campusmap.ucdavis.edu/sustainability/.
- goClub Green Opportunities is the umbrella for the University's branding of its alternative transportation programs.
- The intra-campus shuttle between campuses is free to undergraduates for travel around the city; there is a subsidy for graduate students depending on transit choice.
- UC Davis is well-known as a bike campus and the city of Davis as a bicycling town. Twenty thousand bikes are on campus daily. The bike programs started in 1971. Traffic signal heads have bike-through indications. The Bike Barn provides repairs and has 150 bikes available to rent.
- The University received a Gold award as a Bicycle Friendly University by the League of American Bicyclists.
- Unitrans is the student-operated transit system that has been recognized as a national model.

Planning Documents and Transportation Websites

The available UC Davis planning documents are summarized in Table 4-24.

Table 4-24
Modal Split, Duke

Area	Documents	Resource
Campus Master/ Strategic Plan	Long Range Development Plan (2003-2015) Neighborhood Development Plan Research Park Master	http://sustainability.ucdavis.edu/progress/commitment/planning/lrdp.html http://sustainability.ucdavis.edu/progress/commitment/planning/nmp.html http://sustainability.ucdavis.edu/progress/commitment/planning/rpmp.html
Transportation Strategic Plan	Bikeway and Transit Network Study	http://cpcr.ucdavis.edu/btns/documents/UCDavis-BTNS-part1.pdf
Sustainability	Sustainable 2nd Century Sustainable Transportation Center of the Institute of Transportation Studies	http://sustainability.ucdavis.edu/topics/transportation/index.html http://stc.ucdavis.edu/
Transportation Goals	Goal is to reduce 2000 emission levels by 12% by 2014. This has already been achieved. Core campus closed to vehicles; planning improvements to major bike/pedestrian boulevard running through campus.	

Sustainability Ratings

According to the 2011 CSRC [33], UC Davis received an "A" for its sustainable transportation efforts.

> UC Davis offers ride-matching services and preferable parking to carpoolers, and all campus community members receive discounts on local public transit. The college provides shuttle services to other campuses and to local attractions. The Bike Barn provides rentals and repairs, and a car-sharing program is available. The administration is in the process of increasing accessibility for pedestrians. (http://www.greenreportcard.org/report-card-2011/schools/university-of-california-davis)

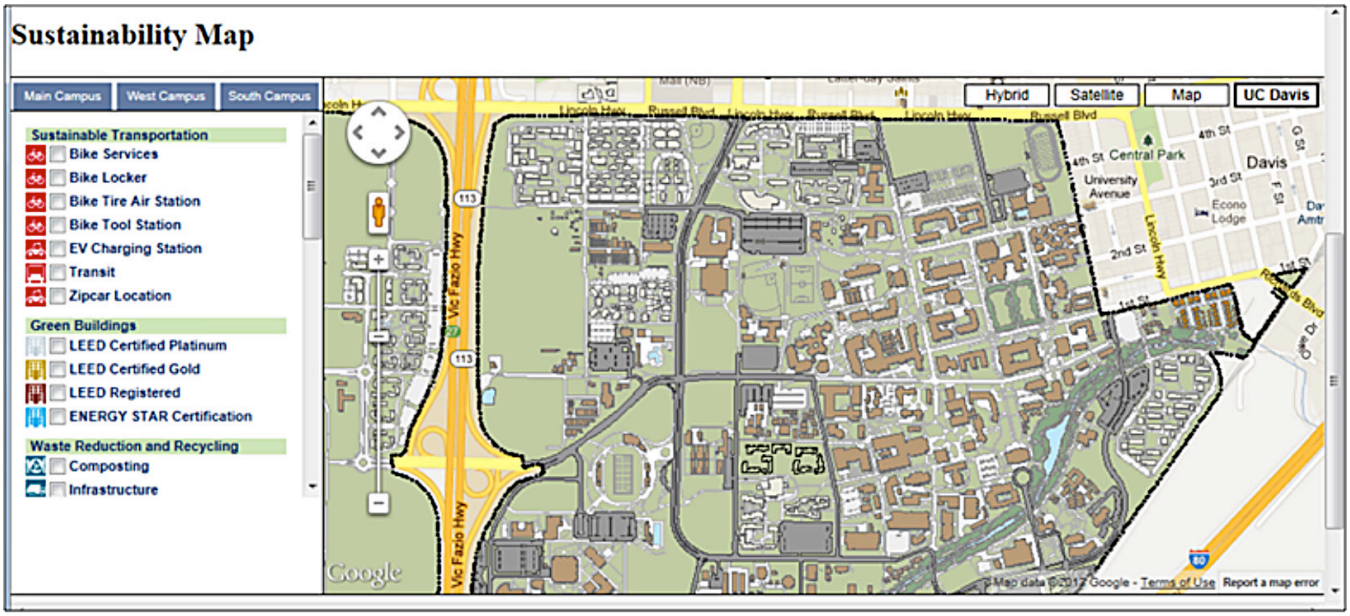
In addition, UC Davis received a Gold award from the League of American Bicyclists as a Bicycle Friendly University. The Bicycle Friendly University program recognizes universities for promoting and providing a more bicycle-friendly campus for students, staff and visitors. UC Davis is one of two universities to receive the Gold award.

Sustainability Map

The Sustainability Map is an innovative tool for promoting the use of alternative transportation. This interactive map provides access to locations of bike services, bike lockers, bike tire air station services, EV charging stations, transit, and Zipcars. In addition, it highlights the locations of LEED-certified buildings. A screen shot is shown in Figure 4-8.

Figure 4-8

UC Davis Sustainability Map Website



Source: http://campusmap.ucdavis.edu/sustainability/

Local Transportation Alternatives

In 1991, UC Davis and the City completed a joint transportation system management plan to reduce dependence on SOVs. This collaborative effort resulted in a successful management system that has promoting alternative transportation programs at the University. The circulation systems are integrated under goClub Green, the name of the University's alternative transportation programs. With goClub, members receive benefits from goCarPool, goTrain, goBike, goVanpool, and goWalk. Car-Sharing, rideshare matching, bicycle parking, emergency ride home, and other incentives are other components of its alternative program.

UC Davis offers ride-matching services, preferable parking to carpoolers, and discounts on local public transit. The University provides shuttle services to other campuses and to local attractions. The Bike Barn provides rentals and repairs, and a Car-Sharing program is available.

Transit

The University's transit profile is summarized in Table 4-25.

Table 4-25

Transit Profile, UC Davis

Transit Subsidy	Undergraduate students receive free Unitrans passes; goClub faculty, staff, and graduate students living off campus in Davis can purchase discounted Unitrans passes; discounted fares on other public transit operators.
University Shuttle	Operated by students and partially supported by City; national model
Transit Operators	Unitrans, Yolobus, Med-Transit, Sacramento Regional Transit, Solano

Profile at UC Davis

The transit system plays a major role in the University's circulation network. Unitrans, which provides the bulk of local service with support from the City of Davis, is owned and operated by the University through the Associated Students, UC Davis. Unitrans routes radiate from the Central Campus to all areas of the city of Davis, including the downtown, major shopping centers, middle and high schools, and medical destinations. Unitrans is largely a student-run system and is a national model of successful campus-based transit. Approximately 95 percent of Unitrans travel is powered by clean-burning compressed natural gas (CNG), in partnership with the City of Davis.

Unitrans has more than 40 buses on 15 routes carrying more than 3 million passengers per year. Each weekday, 20,000-plus Davis residents ride buses to get to destinations on campus and throughout the city.

Yolobus provides additional service to the campus and region; Greyhound and Amtrak provide bus and rail service to the Davis Intermodal Terminal, which is within walking distance of the Central Campus (http://goclub.ucdavis.edu/guidelines/guidelines.html#goCarpool).

Mobility Assistance Shuttle

The Mobility Assistance Shuttle provides on-campus rides to specified locations for academic or work-related purposes year-round. All rides are on-campus to specified locations and must be for academic or work-related purposes only. Rides must be scheduled at least 24 hours in advance and are on a first-come-first-serve basis.

Bicycling and Car-Sharing

UC Davis is well-known as a bike campus with a high degree of integration with the City of Davis's bike network. To accommodate the large volume of bike traffic, the Main Campus has a traffic signal with a bicycle phase.

The Bike Barn, which is operated by students, has been growing and adapting to meet the needs of a growing student body. In the early 1980s, the Bike Barn invested in a small fleet of rental bikes for campus visitors and exchange students. Over the last two decades, the fleet has been upgraded several times and increased to more than 150 bikes, including tandem bikes. Most recently, the bike shop was reorganized to accommodate more repair stands to increase the number of repairs done per day. The front of the shop was also reorganized to provide more room for customers to browse as well as a larger area to do their own repairs. The shop is one of the busiest in the country, doing more than 10,000 repairs per year.

The Bike Garage provides most of the tools necessary to perform basic to advanced repairs on bicycles. This service is free to students, staff, and faculty who have a UC Davis identification card. The Bike Garage is staffed with at least one fully-trained bike mechanic to assist customers with their repairs. Bike and car-sharing services are summarized in Table 4-26 (carpooling and vanpooling availability is shown in Table 4-27).

Table 4-26

Bicycling and Car-Sharing, UC Davis

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rental	Bike Barn	Bike Barn	Yes
Year started	1971	1971	2009
Number available	150+		8 hybrid vehicles
Usage fee per hr/day	$15/day		$8/hr, $66/day; weekends $9/hr, $72/day
Service fee		Full service with fees	
Annual fee	No		$35
Other services	Garage shares tools; air stations/tool stations located around campus		

The Davis campus recently completed the Bike and Transit Network Study, detailing a comprehensive plan for bicycle and transit circulation system improvements, as well as recommendations for pedestrian system improvements. The campus has a full-time Bicycle Coordinator in the Transportation and Parking Services unit. Using bicycles is highly supported and promoted at UC Davis. Figure 4-9 is one of the posters used to market bicycling.

Figure 4-9
UC Davis goClub Marketing Poster

Source: http://goclub.ucdavis.edu/

Carpooling and Vanpooling

Table 4-27 shows carpooling and vanpooling services at UC Davis.

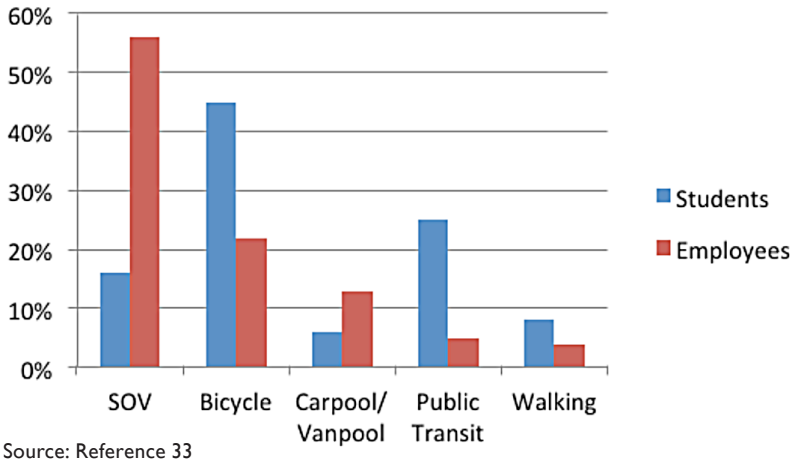
Table 4-27
Carpooling and Vanpooling, UC Davis

Carpooling/vanpooling incentives	Students: Yes; Staff: Yes
Carpool/vanpool matching	Zimride: http://goclub.ucdavis.edu/carpool/zimride.cfm
Ride matching	Zimride: http://goclub.ucdavis.edu/carpool/zimride.cfm

UC Davis Modal Split for Students and Employees

Generally, students use more alternative transportation modes than employees. An impressive 84 percent of students use alternative transportation, with 45 percent using bicycles and 25 percent using transit. A significant factor in such high usage is that 84 percent of students live on or near campus. A detailed summary is provided in the Figure 4-10 and Table 4-28.

Figure 4-10
Carpooling and Vanpooling, UC Davis



Source: Reference 33

Table 4-28

Modal Split, UC Davis

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	16%	45%	6%	25%	8%
Employees	56%	22%	13%	5%	4%

Campus Motor Fleet

The use of alternative fuels in the UC Davis campus motor fleet is summarized in Table 4-29.

Table 4-29

Table 4-29 Campus Fleet, UC Davis

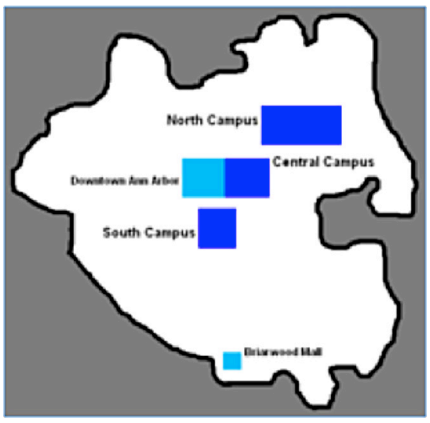
Campus motor fleet	880
Type of alternative fuel	
100% electric	29
Fueled with B20 or higher	78
Gasoline-electric hybrid	56
BF-1 unleaded & ethanol	43
BF-3 unleaded and natural gas	40
Natural gas	8
Total (%) alternative fuel vehicles	*254 (29%)*

Source: Reference 33

University of Michigan (UM)

UM as a Multi-Nodal University

The University of Michigan is located in Ann Arbor, which has a population 283,904. The University has four campuses in the city. The student population is 41,042, including 38,096 full-time and 2,946 part-time students. Forty percent of students live on-campus.



The four campuses are located within six miles (9.66 km) of each other: North, Central, Medical, and South. The Central and South campuses areas are contiguous, while the North Campus area is separated from them, primarily by the Huron River. Because Ann Arbor and the Central Campus developed simultaneously, there is no distinct boundary between the city and university, and some areas contain a mixture of private and university buildings. South Campus is the site for athletic programs, including major sports facilities. East Medical Campus includes several university-owned buildings for outpatient care, diagnostics, and outpatient surgery. All four campus areas are connected by bus services,

the majority of which connect the North and Central campuses. There is a shuttle service connecting the University Hospital, which lies between North and Central campuses, with other medical facilities throughout northeastern Ann Arbor.

Transportation Highlights

- The University's most recent Master Plan Update occurred in 2008.
- UM buses are free with operation of the AVL Magic Bus to 4 campuses; 6 million riders per year are accommodated.
- Free M-Ride, provided by the Ann Arbor Transportation Authority, operates 78 buses on 27 routes.
- 61% of the University's 1,077 vehicles use alternative fuels, one of the largest percentages in the country.
- There are no bicycle services or rentals; no modal split data are available for students.

Planning Documents and Transportation Websites

Significant University planning documents are summarized in Table 4-30.

Table 4-30

Campus Planning Documents and Websites, UM

Area	Documents	Resources
Campus Master/ Strategic Plan	Medical Center Master Plan (2005) North Campus Master Plan (2008)	http://www.umaec.umich.edu/campus.plans/MC%20master%20plan%20FINAL-June%202005.pdf http://www.umaec.umich.edu/campus.plans/U-M%20North%20Campus%20Master%20Plan%20Update%20-%203.5.09.pdf
Transportation Strategic Plan	City of Ann Arbor Master Transportation Plan	http://www.a2gov.org/government/publicservices/systems_planning/Transportation/Documents/2009_A2_Transportation_Plan_Update_Report.pdf
Transportation Website		http://pts.umich.edu/

Sustainability Ratings

According to the 2011 CSRC [33], UM received a "B" for its sustainable transportation efforts.

> The university fleet includes 655 alternative-fuel vehicles. The M-Ride program enables all students and employees to ride local transit buses for free anywhere in the Ann Arbor area. A car-sharing program featuring ten vehicles helps reduce traffic on campus.(http://www.greenreportcard.org/report-card-2011/schools/university-of-michigan-ann-arbor)

Local Transportation Alternatives

Transit

The University's transit profile is summarized in Table 4-31.

Table 4-31
Transit Profile, UM

M-Ride	Unlimited access
University Shuttle	UM Magic buses (equipped with AVL)
Transit Operators	Ann Arbor Transportation Authority

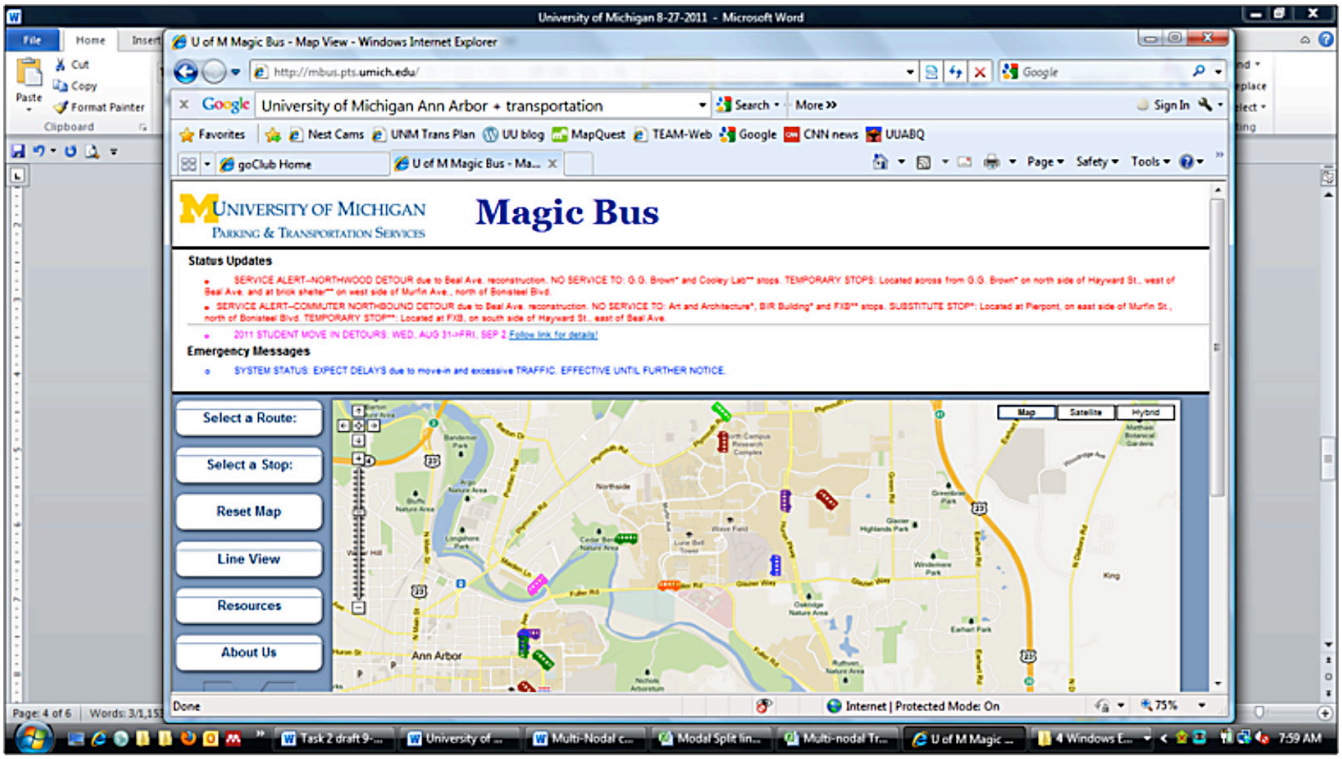
UM students, faculty, and staff can ride without paying a fare through the M-Ride program by presenting a valid yellow UM identification. This benefit is a result of a five-year agreement between UM and the Ann Arbor Transportation Authority (AATA), valued at $1.8 million annually.

The unlimited access service, called AATA's M-Ride Program, benefits both the University and the surrounding community. The city bus system operates 78 buses on 27 routes throughout Ann Arbor and Ypsilanti, the town to the east. AATA carried about 6,000,000 passengers in FY 2008. The University bus system is operated by the University of Michigan's Parking and Transportation Services department and operates 60 buses on 20 routes.

The Magic Bus (http://mbus.pts.umich.edu/index.php) has AVL that includes an interactive map of routes, stops, and transit lines, improving the experience of University bus passengers by enabling students to see where buses are and when they can be expected at bus stops. This student-run project is a joint effort, funded by the Parking and Transportation Services Department and implemented by the College of Engineering's Atmospheric, Oceanic, and Space Science Department. The Magic Bus website is shown in Figure 4-11.

Figure 4-11

UM Magic Bus website



Source: http://mbus.pts.umich.edu/

Paratransit Service

The University's Paratransit service offers door-to-door transportation free of charge to faculty, staff, and students who have either temporary or permanent physical disabilities. The service operates Monday through Friday, year round, except for official University holidays.

Bicycles

The University promotes bicycling as a sustainable means of transportation for faculty, staff, and students. Bicyclists have many route options, with a growing network of bike lanes and off-road pathways in the city. Also, many of the roads on and around campus are low-volume, low-speed roadways where bicycles and motorists can share the road.

As of spring 2009, there were more than 8,500 bike parking spaces (each hoop provides 2 parking spaces) on UM's Ann Arbor campus. This translates to about 1 place for every 10 people within an academic, research, and office building on campus and 1 place for every 4 people living in a residence hall.

Secured, indoor bicycle parking is available, out of the elements and accessible only to those with rented space. Rental of bicycle storage space is $72 per parking permit year. Other than bike storage, there are no other bike resources available. Bike and car-sharing details are summarized in Tables 4-32 and 4-33.

Table 4-32
Bicycling and Car-Sharing, UM

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rentals	Bike storage	None	Zipcar
Year started			2005
Number available			10
Usage fee per hr/day			$8/hr
Annual fee			$25

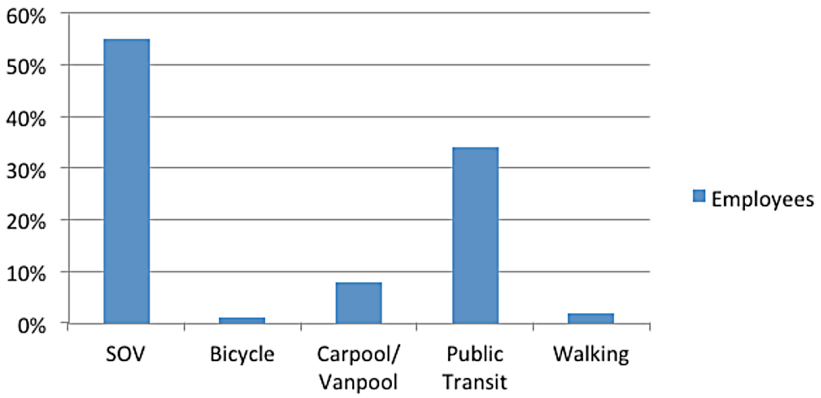
Table 4-33
Carpooling and Vanpooling, UM

Carpooling/vanpooling incentives	Students: Yes; Staff: Yes
Carpool/vanpool matching	http://umich.greenride.com/en-US/
Ride matching	http://zimride.pts.umich.edu/

Modal Split Data for Employees

Modal split data for UM employees are detailed in Figure 4-12; similar data were not available for students.

Figure 4-12
Modal Split for Employees, UM



Campus Motor Fleet

Sixty-one percent of the University of Michigan's campus fleet uses alternative fuels, with 50 percent of the fleet using E85 or higher biofuel. The University is a leader in the use of alternative fuels. Summary statistics are shown in Table 4-34.

Table 4-34
Campus Fleet at UM

Campus motor fleet	1,077
Type of alternative fuel	
100 % electric	6
Fueled with B20 or higher*	96
Fueled with E85 or higher biofuel	545
Gasoline-electric hybrid	14
Total (%) alternative fuel vehicles	*661 (61%)*

Source: Reference 33

University of Texas at Austin (UT Austin)

UT Austin as a Multi-Nodal University

The University of Texas at Austin comprises two campuses: the Main Campus and the J. J. Pickle Research Center, which is located 10 miles (16.1 km) away. The Austin metropolitan area is an urban center with a population of 1,012,638. Student enrollment is 50,995, including 46,111 full-time and 4,884 part-time students. Approximately 70,000 persons access campus on a daily basis. On-campus housing is used by 15 percent of the students.

Transportation Highlights

- The Campus Master Plan's goal is to reduce vehicular traffic and promote alternative modes.
- UT Austin received a Sustainability Report Card of Gold and an AASHE STARS rating of Silver and was recognized as a Best Workplace for CommutersSM.
- Parking and Transportation Services' transportation theme is "Green on the Go: Advocating alternatives to the single-occupancy vehicle."
- 64% of students use alternative transportation; 35% of them are transit users.
- 64% or 400 of 630 vehicles use alternative fuels.
- Automated gates limit access to the core campus; parking is on the periphery.
- The UT Shuttle is operated by Capital Metro and is the largest university shuttle system in the country, with 14 routes and more than 7.5M passengers annually. Shuttles are provided to high-population residential areas.
- Innovative bicycle programs include the Orange Bike Project, a bike-sharing program with 50+ bikes, and the Kickstand (university bicycle hub), a mobile bicycle information center, a bicycle registration location, and a site to check out u-locks and provide basic bike maintenance.
- New students parking orientation available at http://www.utexas.edu/parking/brochures/student-parking-2011.pdf.

- The Annual Reports for 2002 to 2010 provide very detailed information on parking, alternative transportation, and fleet services, including statistics and financial information (http://www.utexas.edu/parking/about/annual_report/annual_report_0910.pdf).

Planning Documents and Transportation Websites

The goal in the UT Master Plan is to reduce the number of vehicles on the core campus to make it a pedestrian campus. Modifications to the street network in and around the central part of the campus have been made to improve circulation, street crossings, the walking atmosphere, and conflicts among pedestrians, bicycles, and vehicles on sidewalks and streets.

Bikes in combination with the Austin Light Rail system have been promoted to shorten the time needed to cross the campus, and buses that loop the campus have been included as alternative means of transportation. Cars will have limited presence in the central area of campus, and future parking needs will be accommodated by the addition of structure parking.

Data indicate that 10 minutes is the maximum amount of time people are willing to walk between buildings. The transportation network of buses and shuttles has been redesigned to conform to this 10-minute interval, making foot traffic more leisurely within a park-like environment. Relevant websites are summarized in Table 4-35.

Table 4-35

Campus Planning Documents and Websites at UT Austin

Area	Documents	Resources
Campus Strategic/ Master Plan	University of Texas System Strategic Plan 2006-2015	http://www.utsystem.edu/osm/planning.htm
Campus Master Plan	UT at Austin Campus Master Plan (1999)	http://www.lib.utexas.edu/books/campusmasterplan/
Austin Transit Master Plan	All Systems Go Long Range Master Plan	http://allsystemsgo.capmetro.org/all-systems-go.shtml
Parking and Transportation Services	Slogan: "Green on the Go: Advocating alternatives to single-occupancy vehicles"	http://www.utexas.edu/parking/transportation/

Sustainability Ratings

According to the 2011 CSRC [33], UT Austin received an "A" for its sustainable transportation efforts.

> Half of the school community travels to campus via alternative modes of transportation, and the university offers carpool incentives and free access to public transportation to students

and staff. UT Austin operates shuttles to high-population residential areas, runs a bike-sharing program, and is working to make the campus more pedestrian friendly. The majority of vehicles in the campus motor fleet run on alternative fuels.

In addition, UT Austin received a Silver award from the Sustainability, Tracking, Assessment, and Rating System (STARS). STARS is sponsored by the Association for the Advancement of Sustainability in Higher Education (AASHE). UT Austin was also recognized by the National Center for Transit Research as a Best Workplace for Commuters[SM].

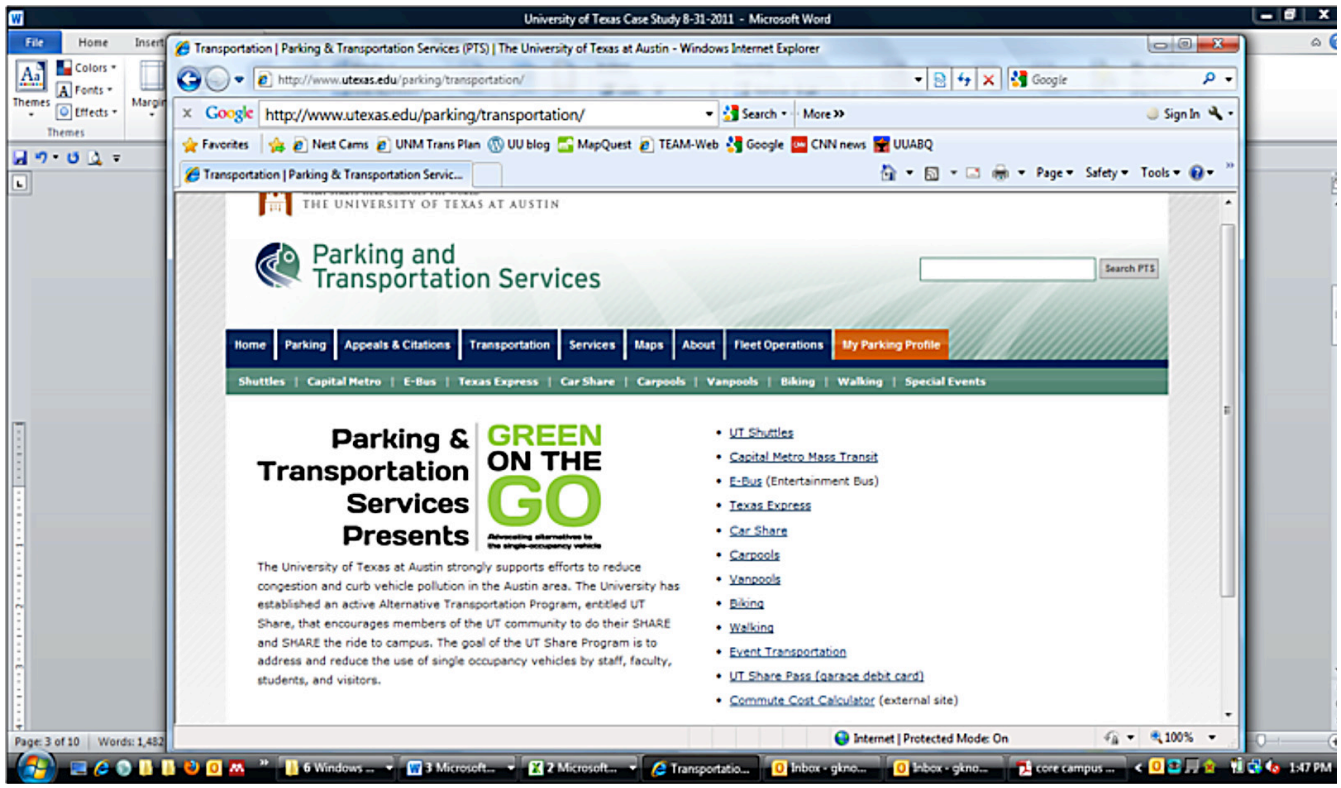
Local Transportation Alternatives

The University has established an active alternative transportation program called UT Share Pass that encourages members of the UT community to "do their share and share the ride" to campus. The goal of the UT Share program is to address and reduce the use of single occupancy vehicles by staff, faculty, students, and visitors.

The Parking and Transportation Services Web presence is well-organized and reflects the sustainability transportation goals of the University (see Figure 4-13).

Figure 4-13

UT Parking and Transportation Services Sustainability Website



Source: http://www.utexas.edu/parking/transportation/

Transit

The UT transit profile is summarized in Table 4-36.

Table 4-36
Transit Profile, UT Austin

UT Share Pass	Free to all students and employees
University Shuttle	UT Shuttle
Transit Operators	Capital Metro

UT Shuttle

Approximately 15,000 students, or one-third of those enrolled at the University, use public transit as their primary means of transportation to and from campus. Capital Metro operates a highly-successful University-oriented bus system that accommodates nearly 50,000 one-way passenger trips each day. The shuttle bus network comprises two distinct systems.

The UT Shuttle System is recognized as the largest university shuttle system in the country. Capital Metropolitan Transportation Authority (Capital Metro) provides transportation services for the UT Austin campus under a 10-year contract through 2020, entered into by Capital Metro and the UT System Board of Regents. The FY10–11 contract called for a service cost of $5,846,807 ($37.99 per shuttle service hour) providing a total of 142,000 hours of shuttle service.

There are 14 UT shuttle routes serviced by 87 buses. Ten routes are radial, 3 are circulator and 1 is inter-campus to the Pickle Research Center. There were 5,359,496 passenger boardings on UT Shuttles for the 2009/10 academic year. A Shuttle Bus Customer Satisfaction Survey is administered regularly to get feedback to improve the service. UT Shuttle has an interactive map with routes and bus stops at http://wwwutexas.edu/parking/transportation/shuttle/routes/?route=640.

Capital Metro

Along with the dedicated shuttle routes, the contract with Capital Metro provides fare-free use of all mainline services for all UT students, staff, and faculty. University affiliates simply swipe their UT ID into the fare box upon boarding any of the 92 routes available through mainline transit. For the 09/10 academic year, there were 2,369,740 boardings on capital Metro mainline buses.

E-Bus

E-Bus is a fare-free, evening transit service that provides safe transportation to Austin's entertainment district during weekend evenings (Thursday–Saturday, 8:30 PM–3:00 AM). E-Bus is a joint venture of the Austin Police Department, the UT Student Government, PTS, and Capital Metro. Three routes serve the main campus, west campus, and Riverside student housing areas. Total ridership for the 2009/2010 academic year was 230,275 passengers.

Bicycles

Bicycles are a popular transportation option around campus and in Austin as a whole and are a significant component of the University's plan to reduce local traffic congestion and air pollution. Each year, work continues to improve bicycling on campus, including two innovative programs: the Orange Bike Project and the Kickstand.

The Orange Bike Project is a subcommittee of the Campus Environmental Center at the University. It has volunteers, enthusiasm, and access to used bikes, tools, and a space in which to work. Through the program, students are able to check out a bike the same as a library book and keep the bike for the entire semester. This allows many students to make a bike their primary mode of transportation.

The Kickstand is the new university bike hub. Located on Speedway Plaza, it is a one-stop shop for all biking needs. Bikes can be registered; helmets, locks, hand pumps, lights, tubes, patch kits, bike lube, water bottles, or other biking supplies can be purchased; locks, air pumps, or tools can be rented; and numerous maps and brochures can be picked up. University Health Services also offers low-cost helmets that can be purchased at the pharmacy located in the Student Services Building.

Details on bicycling and car-sharing at UT Austin are shown in Table 4-37.

Table 4-37
Bicycling and Car-Sharing, UT Austin

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair*	
Sharing/rentals	Orange Bike Project	Yes	Zipcar
Year started	2008		
Number available	50+		
Service fee		Minor fixes; no fee	
Annual fee			$35
Usage fee per hr/per day	$0/$0		$8/hr

Carpooling

Carpool members are provided numerous incentives to share the commute with a fellow co-worker or student, as summarized in Table 4-38.

Table 4-38
Carpooling, UT Austin

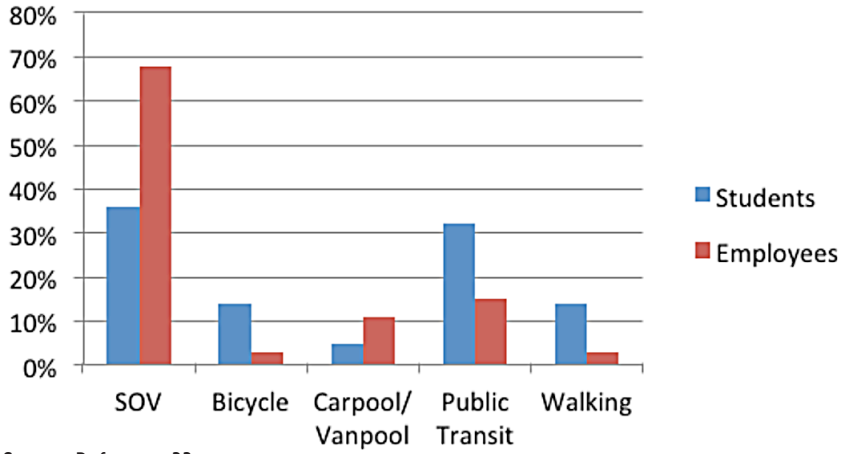
Carpooling incentives	Students: Yes; Staff: Yes
Carpool/vanpool matching	AlterNetRides
Ride matching	Register @RideShare.com
Preferential parking	Reserved spaces for carpoolers

Carpooling benefits and incentives include reserved carpool parking spaces, available throughout the campus and open on weekdays until 10:00 AM to all carpoolers with valid permits on a first-come first served basis. Permit costs are reduced by $50 for each registered UT Austin employee or student carpool rider (excluding the driver) up to the pro-rated cost of the permit at the time of carpool registration. Any remaining permit cost is shared with other carpool members. In the event a person needs to drive a personal vehicle to work instead of riding with the registered carpool, a parking space may be provided in one of the university parking garages. Each carpool member who lists their own alternate vehicle receives a UT Share Pass (garage debit card).

UT Modal Split for Students and Employees

In general, students use more alternative transportation modes than employees, with students at 62 percent and employees at 32 percent. Details are summarized in Figure 4-14 and Table 4-39.

Figure 4-14
Modal Split, UT Austin



Source: Reference 33

Table 4-39
Modal Split, UT Austin

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	36%	13.80%	5%	32%	13.80%
Employees	68%	3%	11%	15%	3%

Source: Reference 33

Campus Motor Fleet

Campus motor fleet statistics are summarized in Table 4-40. A large percentage of UT Austin's vehicles use alternative fuels.

Table 4-40
Campus Fleet, UT Austin

Campus motor fleet	630
Type of alternative fuel	
100% electric	105
Fueled with B20 or higher	48
Fueled with E85 or higher biofuel	107
Gasoline-electric hybrid	3
Propane capable (LNG)	137
Total (%) alternative fuel vehicles	*400 (63%)*

Source: Reference 33

University of Washington (UW)

UW a Multi-Nodal University

UW has three campuses, in Seattle, Tacoma, and Bothell. UW's main campus is located in Seattle, an urban community with a population of 608,660. The Seattle campus has a student population of 51,150, with 42,704 full-time and 8,446 part-time students. Approximately 23 percent of student housing is on-campus.

UW Tacoma is located 33 miles (53.1 km) south of Seattle. UW Tacoma was founded in 1990 and is a small urban campus; it can be walked from end-to-end in five minutes. Currently, UW Tacoma serves 3,000 students and has 7 academic units. UW Bothell is located in a suburban community 20 miles north of Seattle and has 2,600 students.

Transportation Highlights

- The Campus Master Plan promotes pedestrian and bicycle-friendly policies.
- An impressive 87% of students and 59% of employees commute via alternative modes. Walking has an outstanding 36% student share.
- Sustainability Report Card = A; Bicycle Friendly University = Silver.
- Sustainability Metric Dashboard includes transportation reports on sustainability rankings by mode; the site is very user-friendly with good visuals.

- Reports readily available on U-PASS for last 10 years include a biennial survey on modal trips, annual traffic counts, bike rack utilization and capacity, and minutes of University Transportation Committee meetings from 2003 to the present.
- Slogans are used to express UW's transportation sustainability goals, including Facilities Services: "Serving today … preserving tomorrow" and Transportation Services: "Four Programs—One Mission."
- U-PASS is available for use with all six Central Puget Sound transit agencies and provides discounts for carpool permits/car-sharing program. U-PASS users are eligible for discounts at participating merchants. U-PASS costs for students are $99 per quarter and for employees $132 per quarter.
- NightRide Shuttle is available to destinations of choice within a one-mile radius of campus.
- A shuttle operates between the Medical School and research areas; Health Sciences Express buses travel between UW, affiliated hospitals, and branch facilities.
- U-Powered U-PASS is an innovative program that enables walkers and bikers to get U-PASS benefits.
- All three campuses prohibit vehicles from the center of the campus.
- Local bike/pedestrian trails are connected to Seattle's regional network.
- A Bicycle Parking Inventory and Utilization survey are conducted annually.

Planning Documents and Transportation Websites

Important document sites are listed in Table 4-41.

Table 4-41

Campus Planning Documents and Websites, UW

Area	Document	Resource
Campus Master/ Strategic Plan	University of Washington Master Plan (Seattle Campus)	http://www.washington.edu/community/cmp_site/final_cmp.html
Transportation Strategic Plan	Transportation Master Plan, part of Campus Master Plan	http://www.washington.edu/community/cmp_site/cmpfinal/07_TMP_FP.pdf
Transportation Goals	To be carbon-neutral by 2035; to reduce percentage of individuals driving alone to 20% or less (2010 = 21%)	
Transportation Website		http://www.washington.edu/facilities/transportation/
Transportation Slogan	Transportation Services: "Four Programs—One Mission"	

Sustainability Ratings

According to the 2011 CSRC [33], UW received an "A" for its sustainable transportation efforts.

All campus community members participating in the U-PASS program receive unlimited public transit passes and discounts on carpool permits and the Car-Sharing program. Student government runs a non-profit bike repair shop, and 88 percent of students and 62 percent of employees commute via environmentally preferable means. (http://www.greenreportcard.org/report-card-2011/schools/university-of-washington)

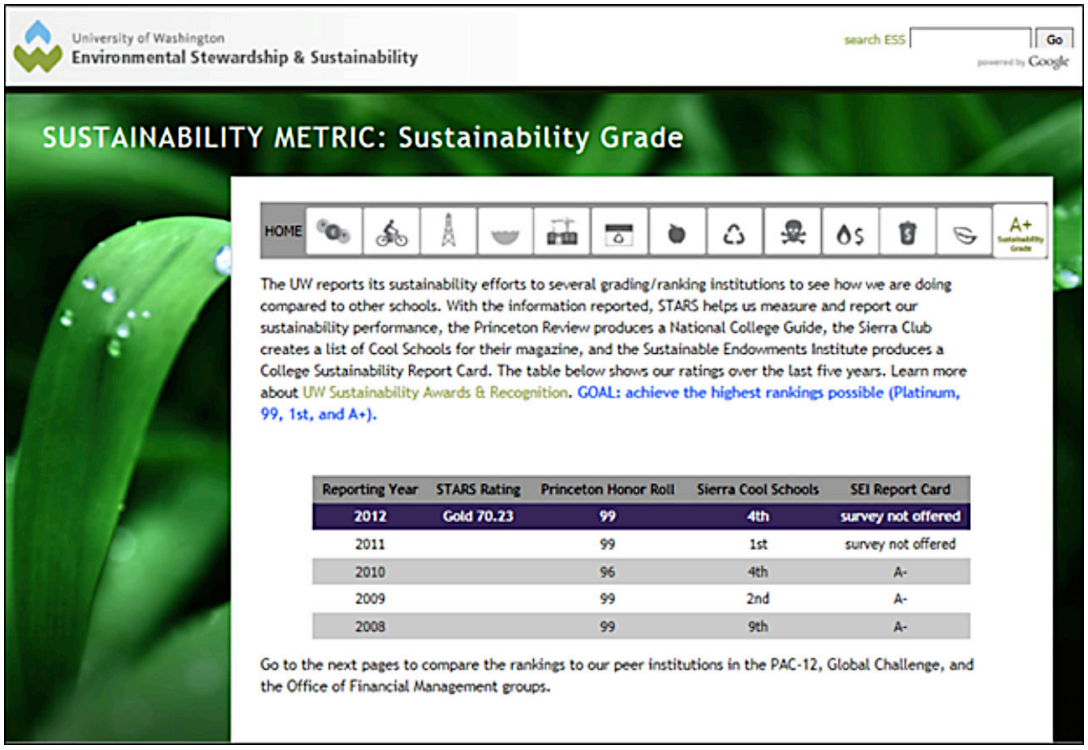
In addition, UW was named as one of the top 12 Bicycle Friendly universities in a ranking by the League of American Bicyclists. It received a Silver award for its strong commitment to promoting a more bicycle-friendly campus for students, staff, and visitors.

Sustainability Dashboard

UW's Sustainability Dashboard is a user-friendly and comprehensive tool for measuring sustainability efforts, with metrics showing reductions in SOV usage, GHG emissions, use of natural resources, increases in waste diversion, and utilities cost savings on the Seattle campus. Figures 4-15, 4-16, and 4-17 are examples of the UW sustainability dashboards.

Figure 4-15

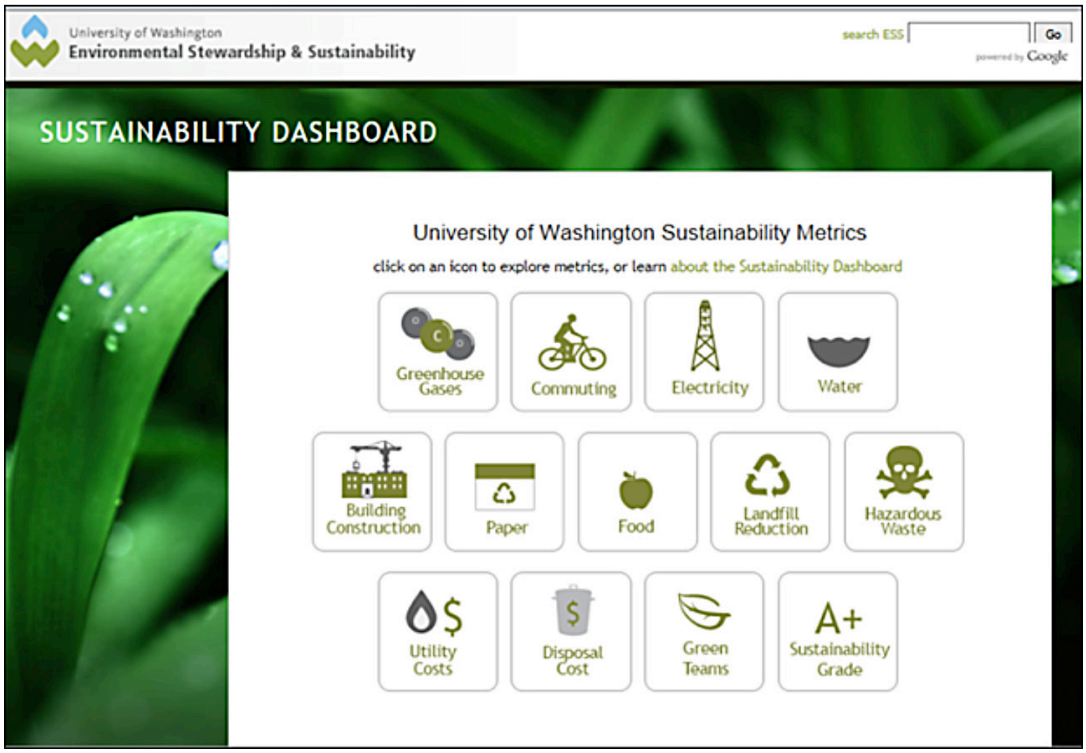
UW Sustainability Metric Dashboard



Source: http://f2.washington.edu/oess/profile/sustainability-grade

Figure 4-16

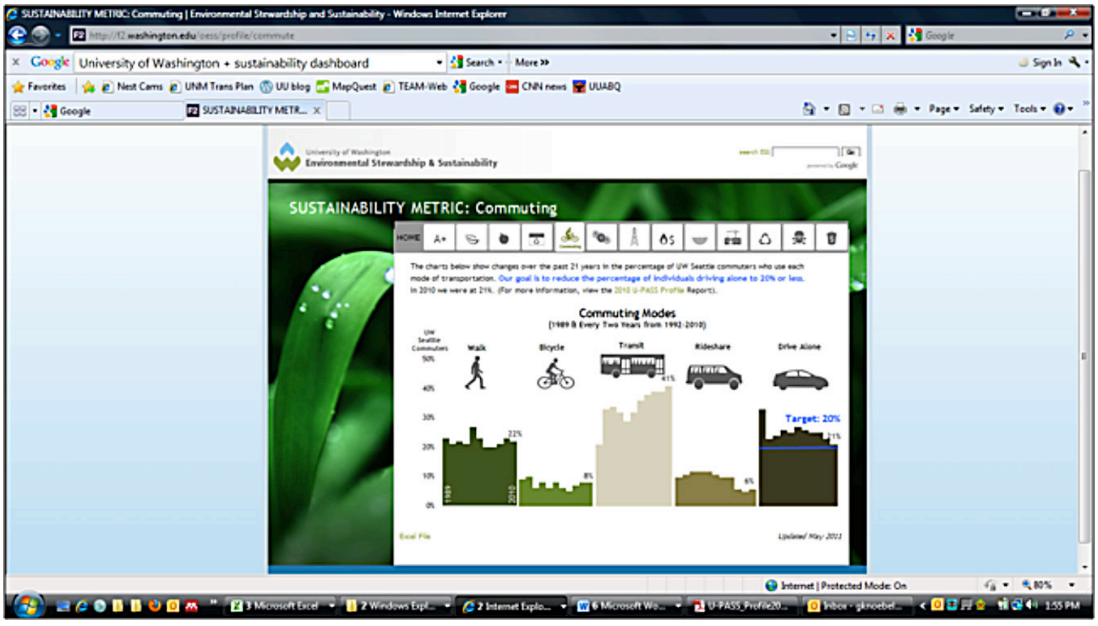
UW Sustainability Dashboard Website



Source: http://f2.washington.edu/oess/profile/SustainabilityMetrics

Figure 4-17

UW Transportation Sustainability Dashboard



Source: http://f2.washington.edu/oess/profile/commute

Local Transportation Alternatives

Transit

More than 60 bus routes serve the U-District, including many that drive onto the campus itself. There are also connections to the UW Seattle campus by train or light rail to downtown Seattle, where riders then get on a bus to the university. A summary of UW transit services is shown in Table 4-42.

Table 4-42
Transit Profile, UW

U-PASS	UW subsidizes the U-PASS, offers unlimited rides on Seattle's six regional transit systems; Student subsidy: 59–74%; Employee subsidy: 46–74%
University Shuttle	See details in text
Transit Operators	King County Metro, Sound Transit (including express bus, light rail, and Sounder commuter rail), Community Transit, Everett Transit, Pierce Transit, Kitsap Transit

UW Shuttle

Shuttles circulate clockwise through campus and pick up passengers at five on-campus stops every 20 minutes until 12:00 midnight. A Dial-A-Ride shuttle is also available for anyone with temporary or permanent mobility difficulties. Anyone still on campus after 8:00 PM Sunday through Thursday can board the NightRide Shuttle from any of the five stops. The shuttle will take them to a location of their choice either on campus or within one mile of campus. The Health Sciences Express assists University faculty, staff, students, and Medical Center patients and their families in conducting University, Health Sciences, and Medical Center business by providing transportation between the University and certain affiliated medical centers. Shuttles are not provided for general purpose intra-campus trips.

U-PASS

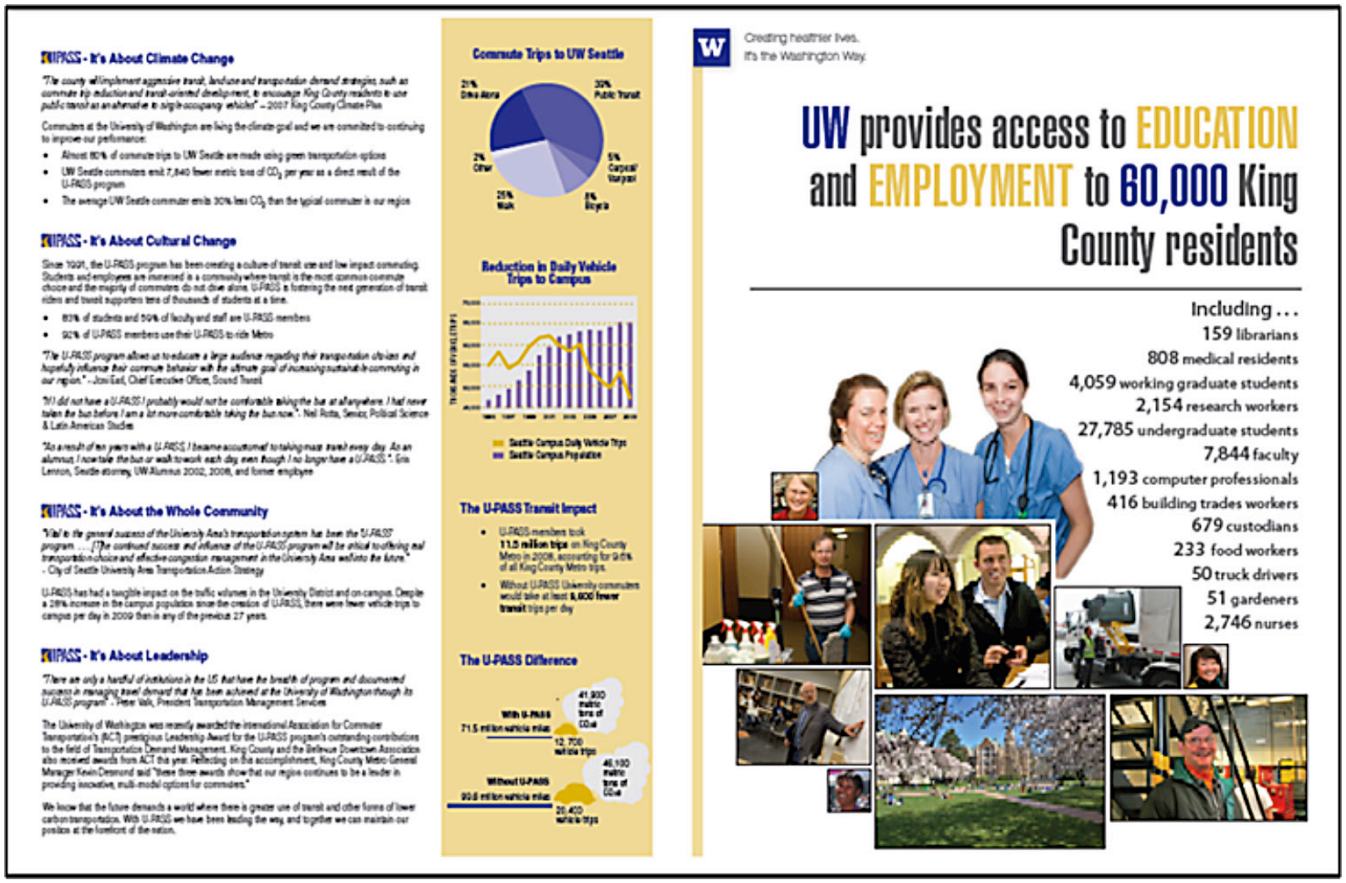
All three UW campuses participate in the U-PASS program, with each operating a fiscally-separate program. For a quarterly fee, participating students, staff, and faculty receive an unlimited, right-to-ride transit pass, which enables them to travel anywhere, anytime on six regional transit systems: King County Metro, Sound Transit (including express bus, light rail, and Sounder commuter rail), Community Transit, Everett Transit, Pierce Transit, and Kitsap Transit. Subsidies exceed $6 million annually. Faculty and staff are also able to purchase an annual U-PASS, which they pay for pre-tax through a payroll deduction. A faculty or staff U-PASS costs $132 per quarter (the equivalent of $44 per month), and a student U-PASS costs $99 per quarter (the equivalent of $33 per month). U-PASS members receive a minimum discount of 46 percent

compared to the equivalent bus pass they would need to purchase for their commutes. In addition, U-Pass participants receive benefits that do not come with a traditional bus pass including an Emergency Ride Home Program. More information is available at www.uwb.edu/admin/transportation/upass.xhtml.

U-PASS members took 11.5 million trips on King County Metro in 2008, accounting for 9.5 percent of all King County Metro trips. It is reported that 83 percent of students and 59 percent of employees are U-PASS members. UW has provided annual monitoring reports on the usage of U-PASS since 1991. In addition, UW conducts biennial surveys to measure the proportion of UW commute trips made by various modes of transportation. The U-PASS 2010 report was in the form of a brochure, as illustrated in Figures 4-18 and 4-19.

Figure 4-18

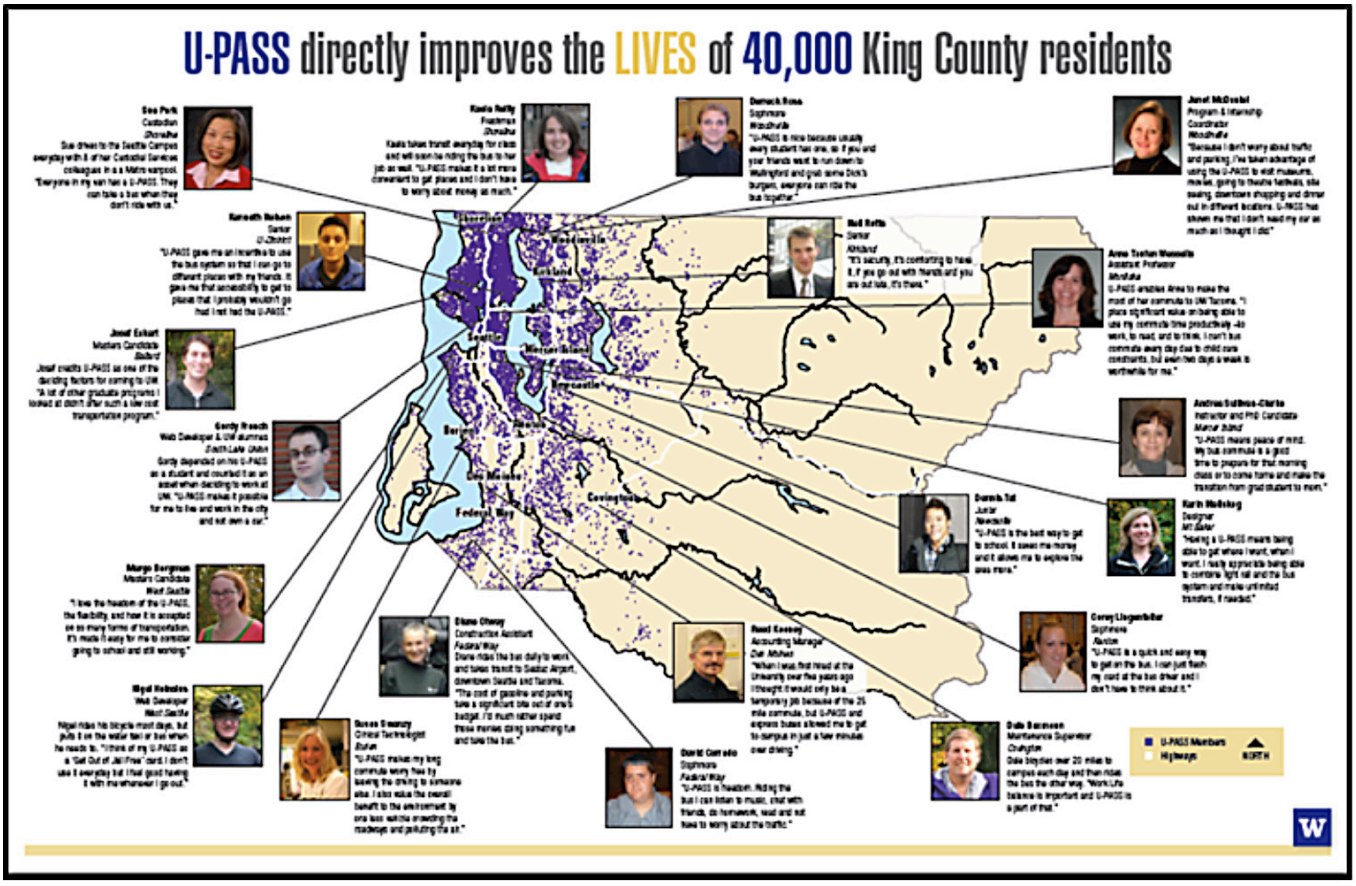
UW's U-Pass 2010 Report (page 1)



Source: http://www.washington.edu/facilities/transportation/commuterservices/files/reports/U-PASS_Profile2010.pdf

Figure 4-19

UW's U-Pass 2010 Report (page 2)



Source: http://www.washington.edu/facilities/transportation/commuterservices/files/reports/U-PASS_Profile2010.pdf

Bicycling and Walking at UW

The UW Seattle Campus supports bicycling and walking in multiple ways. The Campus Master Plan contains pedestrian- and bicycle-friendly policies. Supporting bicycling and walking is a key strategy in the University's Climate Action Plan. Through the U-PASS program, Commuter Services sponsors both bicycling and walking promotions. Bicycle and car-sharing services at UW are shown in Table 4-43.

Table 4-43

Bicycling and Car-Sharing, UW

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rentals	Planning electric bicycle sharing program	ASUW Bike Shop	Zipcar
Number available			8 hybrid vehicles
Usage fee per hr/per day			$7.50– $10/hr; $69–$74/day
Annual Fee			$25

Commuter Services has launched the U-Powered U-PASS to give walkers and bikers some of the benefits of a traditional U-PASS, including merchant discounts, some free bus trips, and discounted parking, but at a lower price. Consideration of bicyclist and pedestrian needs are also incorporated into the building design process on campus. All three campuses prohibit vehicles from the center of campus (except service vehicles).

Through the U-PASS program, the University partners with Zipcar to provide U-PASS members with discounted car-sharing access. U-PASS members receive a discounted membership fee and can use any Zipcar at any time for any purpose. U-PASS members ages 18–20 can join and use on-campus vehicles, and members ages 21 and over can use any Zipcar vehicle in the national Zipcar fleet. UW has created its own car-sharing program called UCAR for University business, which has a fleet of 59 vehicles, 31 of which are hybrids.

Annual Bicycle Parking Inventory and Utilization Survey

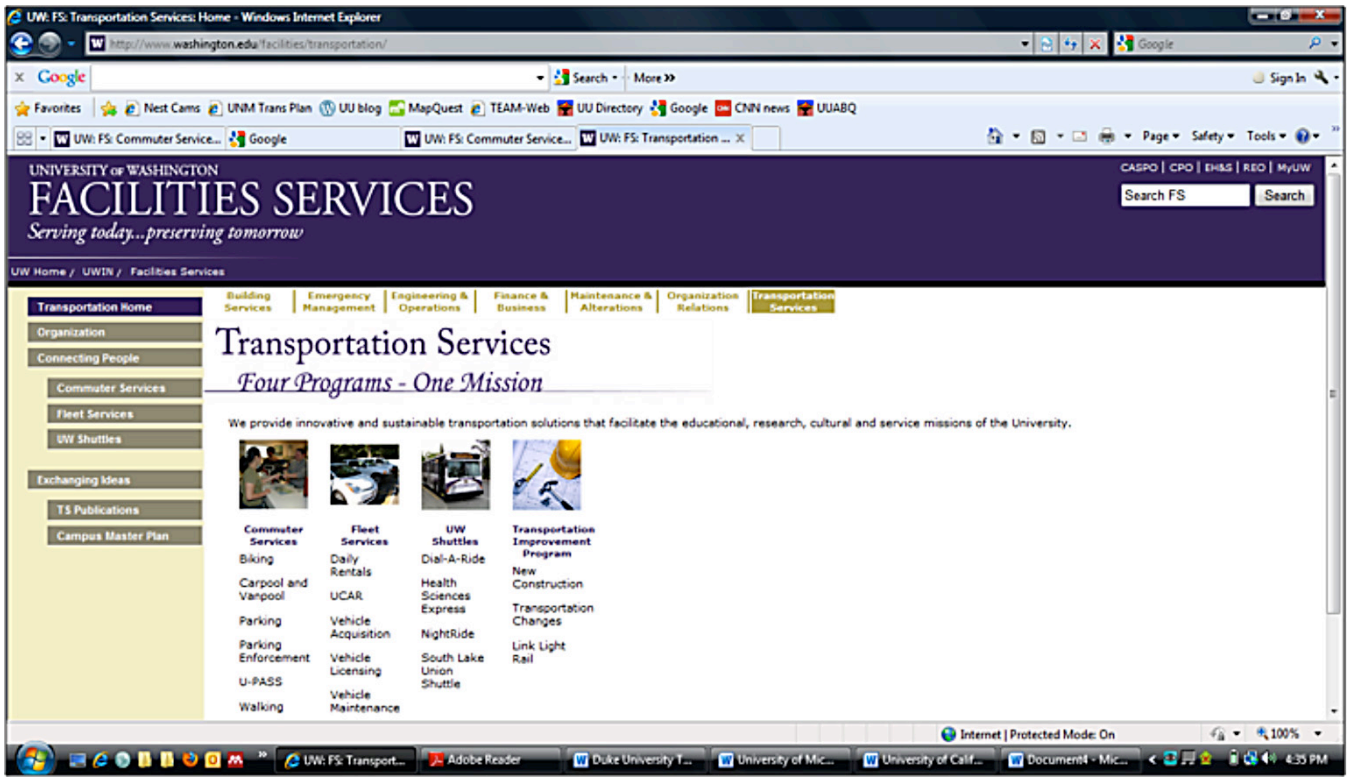
Since 1995, UW's Commuter Services has conducted an Annual Bicycle Parking Inventory and Utilization Survey to assess the adequacy of the University's bicycle parking facilities and identify trends in bicycle parking demand. Knowing how and where UW community members use end-of-trip facilities such as bike racks, lockers, enclosures, and rooms allows Commuter Services to adjust capacity and provide additional end-of-trip services as appropriate The 2,745 bicycles counted in 2010 are the most in the survey's history, and the 55.7 percent bike rack utilization is also a University record. Sixty-seven percent of the bike rack locations across campus had more than 80 percent utilization. Campus-wide, covered rack utilization averaged 62 percent, compared to just 49 percent for uncovered racks. http://www.washington.edu/facilities/transportation/commuterservices/files/reports/2010-Bicycle-Rack-Utilization-Report-FINAL.pdf.

UW Transportation Websites

UW's Transportation Services fall under the umbrella of Facilities Services. Under the Transportation Services portal are UW's commuter services, fleet services, UW shuttles, and Transportation Improvement Program. The organization of these websites is easy to navigate and comprehensive and are displayed in Figures 4-20 and 4-21.

Figure 4-20

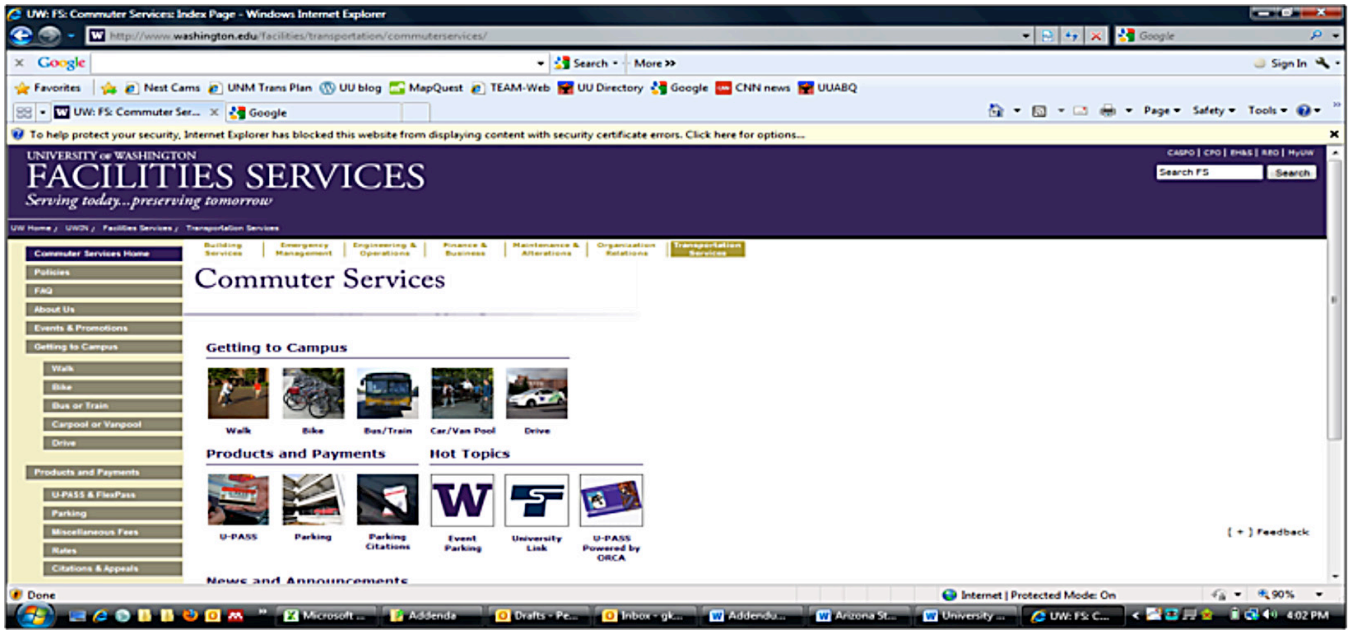
UW Facilities Services Transportation Services



Source: http://www.washington.edu/facilities/transportation/

Figure 4-21

UW's Commuter Services Website

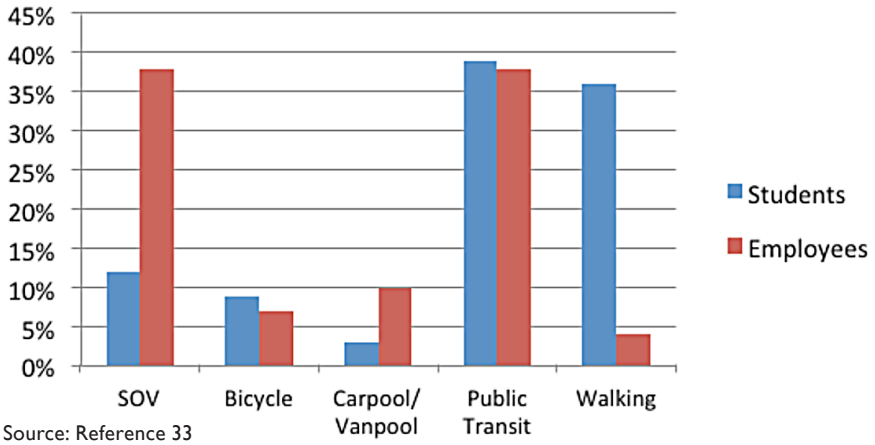


Source: http://www.washington.edu/facilities/transportation/

UW Modal Split for Students and Employees

In general, students use more alternative transportation modes than employees. A very high percentage of students and employees use alternative transportation modes: 88 percent of students and 62 percent of employees. Nearly 40 percent of students and employees use transit. Summaries are shown in Figure 4-22 and Table 4-44.

Figure 4-22
Modal Split, UW



Source: Reference 33

Table 4-44
Modal Split at UW

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	12%	9%	3%	39%	36%
Employees	38%	7%	10%	38%	4%

Source: Reference 33

Campus Motor Fleet

The use of alternative fuel vehicles in UW's campus motor fleet is summarized in Table 4-45.

Table 4-45
Campus Fleet, UW

Total in campus motor fleet	643
Type of alternative fuel	
100% electric	4
Fueled with B20 or higher	46
Gasoline-electric hybrid	59
Plug-hybrid hybrid	3
Total (%) alternative fuel vehicles	*112 (17%)*

Source: Reference 33

Analysis

The seven case studies presented have commonalities that do not necessarily relate to the connectivity needs among universities that have multiple campuses. The resulting transportation needs are addressed primarily through transit.

Findings

Often, multi-nodal universities have hospitals, medical schools, and/or research centers on campuses that are separate from the main academic units. These facilities have differing transportation needs than traditional main campus activities. Hospital shuttle transportation systems, for example, generally accommodate visitors whose transportation patterns differ from main campus-related travel demand needs.

Headways and types of services depend mostly on the distance between campuses. The success of the various university transit operations is dependent upon the vitality of its alternative transportation programs. Key initiatives identified in the case studies include the following:

- Providing transit passes to students and employees allowing free/subsidized access to bus and rail transit (most universities studied).
- Developing high-frequency and late-night transit (most universities).
- Raising parking rates to reduce demand (ASU, UC Davis).
- Restricting first- or second-year students from bringing cars to campus (Duke).
- Creating carpools and vanpools (all universities).
- Providing a Guaranteed Ride Home for employees who participate in transit pass or carpool programs (all universities).
- Allowing compressed work weeks and telecommuting (all universities).
- Providing access to shared vehicles for some trips through nonprofit or commercial car-share programs or on-campus car rentals (all universities).
- Marketing alternative transportation modes in new student orientation programs (most universities).
- Improving infrastructure and adding programs to encourage walking and bicycling (most universities).
- Coordinating with public agencies and neighborhoods viewed as essential for developing integrated transportation systems (Duke, UC Davis).

Observations

Other, more specific, observations gleaned from the case studies include the following.

Sustainability Dashboards

UW's Sustainability Metrics Portal provides sustainability metrics for various aspects of the university's sustainability efforts related to green teams, food, paper, commuting, GHGs, electricity, utility costs, water, building construction,

landfill reduction, and disposal costs and are very user-friendly. (See http://f2.washington.edu/oess/profile/SustainabilityMetrics.) The site describes a graphic representation of modal share data from 1989 to 2010 at http://f2.washington.edu/oess/profile/commute. The dashboard also publishes scores given by sustainability organizations that grade university sustainability efforts at http://f2.washington.edu/oess/profile/sustainability-grade.

University Support for Sustainability Efforts

UC Davis's Sustainability Map is an innovative interactive map that indicates locations of services such as EV charging stations, bike support, transit stops, and Zipcars. The map also indicates LEED building sites. (See http://campusmap.ucdavis.edu/sustainability/.) UC Davis's alternative transportation programs are effectively branded with the goClub Green Opportunities umbrella (http://goclub.ucdavis.edu/).

Other Areas

- Transportation Service Portals: Universities are integrating sustainability goals in the design of their transportation portals; the order of the presentation of transportation modes reflects the values of alternative transportation and is directly linked to sustainability.
  - UW's Transportation Services Portal is comprehensive, well-designed, and reflective of the university's sustainability values and goals.
  - The UT Austin Transportation Portal is comprehensive and reflects the sustainability goals of the university (http://www.utexas.edu/parking/transportation/).
  - The ASU "options" portal to parking and transit services is easy to navigate and includes easy-to-use intercampus maps (http://sustainability.asu.edu/practice/what-asu-is-doing/transportations.php).
- A wide variety of transit operators exist at these multi-nodal universities. For example, at UC Davis, Unitrans is a student-operated and partially city-funded transit system. CSU has a transit center. Transfort, a public agency, serves both the CSU and the city.
- CSU Bicycle Services' "Kickstand" is a mobile bike services hub.
- UC Davis created traffic free entrance to the university. It also has a bicycle throughway signal as well as a roundabout for bikes and pedestrians.
- UW's U-Powered program offers commuters who bicycle or walk to campus the same benefits that U-Pass participants receive.
- Vehicle-free campus cores exist at UT Austin, Duke, and UC Davis.
- Branding is important in alternative transportation marketing and linking to the University's sustainability goals: UT Austin has "Green on the Go:

Advocating alternatives to the single-occupancy vehicle," and UW's Facilities Services has "Serving today … preserving tomorrow."

- An impressive 86% of ASU vehicles use alternative fuels or are hybrid vehicles. One-half of its vehicles are 100% electric. UM has the largest number of alternative-fueled and hybrid vehicles; of its campus fleet of 1,077 vehicles, 661 are alternative-fueled and hybrid.
- In contrast to these positive findings, very little activity was observed among the seven universities in regard to the following:
- The literature focuses on TDM programs with little evaluation of those programs. Whereas notable universities with long TDM histories have experienced shifts in modal usage, many other university TDM programs have only recently been implemented, with little time for significant evaluation.
- AVL systems are one of the few ITS applications found in university transportation operations.

Summary

The focus of these studies was universities with multiple campuses. The only common characteristic among the seven universities, however, is that they each have inter-campus transit to individual campuses. In some instances, it was unclear whether the separate campuses have separate administrations for their parking and/or shuttle services. The headways and transit frequency vary depending on the distances between campuses and the populations at the other campuses. Some campuses, such as ASU, have easily-accessible interactive maps that can be navigated. UM's Magic buses have AVL to track bus location.

Most universities use sustainability as the umbrella for transportation, including parking and alternative transportation modes such as bicycling, walking, carpools/vanpools, and car-sharing. Only a few universities prominently display transportation-related policies, reports, and data on their websites.

The campus master plans and transportation plans of each university recognize the distinct and uniqueness of each campus. However, there is little discussion about connectivity between campuses. The number of routes and headways vary greatly and largely depend on the campus population size and the distance between campuses. Often, there are separate campuses for hospitals/medical schools as well as research centers.

Successful transit is dependent upon a robust alternative transportation system. The level of on-campus or near-campus housing and employment is an important factor in the utilization of alternative transportation.

Recognizing that commuters do not use just one mode of transportation on a regular basis, alternatives such a Guaranteed Ride Home program must be available.

Social media are becoming important marketing and communication tools for university transportation programs. *TCRP Synthesis 99, Uses of Social Media in Public Transportation* [40] reflects the growing importance of these marketing tools. In addition to social media such as Facebook and Twitter, universities are developing smart phone and iPod applications for transit alerts, schedules, and bus locations.

Much of the data used in these case studies have been obtained from university sustainability tracking organizations and university-generated reports including campus master plans. Therefore, university-to-university comparisons may not be possible.

Details for organizations tracking sustainability in universities can be found in Appendix B.

SECTION 5

University of New Mexico Case Study

The previous section described information on the characteristics of seven multi-nodal universities taken from their respective Web sites and university-generated reports, including campus master plans. This section first describes, using the same format, characteristics of UNM. The section then provides additional data collected from various primary and secondary sources in the Albuquerque metropolitan area as well as from data collection efforts conducted by the researchers.

UNM as a Multi-Nodal University

The University of New Mexico has three campuses in urban Albuquerque and one to the west in Rio Rancho 18 miles (29.0 km) away. Albuquerque has a metropolitan area population of 907,755, and the UNM area is the largest activity center in the city, with approximately 74,000 student, employee, and hospital visitors a day.

UNM's three Albuquerque campuses (North, Main, and South) are within about one mile of each other. The University has a student population of 28,757, with 20,479 full-time and 8,278 part-time students; there are an additional 9,800 faculty and staff, mostly on the Main Campus. Only 11 percent of UNM students currently live on-campus, although new on-campus dormitories are being built on the Main Campus as well as in Lobo Village located about 2 miles (3.2 km) away on the South Campus. The North Campus houses the Medical School and Hospital and the Law School. The Main Campus houses the academic activities of the University, and the South Campus is the location of the research park, the University's athletic activities, and large lots that serve as parking locations for both for athletic events and remote parking for the Main Campus.

The main campus of Central New Mexico Community College is located between UNM's Main and South campuses and has a total population of 16,000 students, in addition to faculty and staff; CNM has no independent shuttle service.

Transportation Highlights

- In September 2011, UNM adopted a Consolidated Master Plan for its three campuses, which included a focus on multi-nodal and multi-modal transportation connectivity issues.
- The Mid-Region Council of Governments (MRCOG) is currently conducting a UNM/CNM Travel Demand Management Study, which has been the source of some primary data used in this study.

- In FY 2010, ABQ Ride, the City's transit provider, served 11.7 million riders, a 39% increase from 2009. Ten routes serve the UNM area, with four routes that serve CNM. Approximately 15% or 1.8 million riders are from either UNM or CNM.
- Free ABQ Ride bus passes are provided to UNM students, faculty, and staff; several Lobo shuttles travel between North, Main, and South campuses and a few provide service to the city's downtown transit center connecting to the State's Rail Runner.
- A total of 864 student housing units close to the Main Campus were recently constructed.
- Approximately 51% of students and 41% of employees use alternative transportation; an estimated 4,200 bikes are on campus daily.
- Bike programs (rental/repairs) started in 2008.
- UNM's sustainability motto is "Love Red, Live Green."
- UNM has participated in an application for a multi-modal transit center to be located on the North campus.
- UNM is also participating in an FTA-funded project that is conducting an alternatives analysis study for the heavily-traveled north-south corridor from the UNM/CNM area to the Albuquerque airport.
- There is no shuttle service to UNM's Rio Rancho campus, which is located 18 miles (29.0 km) west of its Central Campus.
- UNM's Strategic Transportation Plan was prepared in June 2009.
- Efforts are underway to establish a Lobo Mobile smart phone application for transit.

Planning Documents and Transportation Websites

Significant planning documents/resources are summarized in Table 5-1.

Table 5-1

Campus Planning Documents and Websites, UNM

Area	Documents	Resources
Combined Master Plan for 3 Campuses	UNM Consolidated Master Plans	http://iss.unm.edu/PCD/docs/ConsolidateMP_Part1and2.pdf
Campus Master Plan	UNM Campus Master Plan Update (2009)	http://iss.unm.edu/PCD/docs/UNM-Master%20Plan-LQ.Oct.2009.pdf
Transportation Master Plan	UNM Strategic Transportation Plan (2009) UNM/MRCOG Travel Demand Study Findings:	http://iss.unm.edu/PCD/docs/Final_UNMTransStrategicPlan_jun2009.pdf http://www.mrcog-nm.gov/images/stories/pdf/transportation/UNM_Study/UNM-CNM_TDM_Report.pdf
Sustainability	Climate Action Plan	http://iss.unm.edu/PCD/docs/Final_UNMTransStrategicPlan_jun2009.pdf
Parking and Transportation Services (PATS)	"We are More than just Permits"	http://pats.unm.edu/

Sustainability Ratings

According to the 2011 CSRC report card [33], UNM received a "B" for its sustainable transportation efforts.

> The University fleet includes at least 84 alternative-fuel vehicles. UNM offers a free ride-matching service and provides preferable parking for fuel-efficient vehicles. Free passes for the Albuquerque bus system are available to all students, faculty and staff. UNM also runs a bike-sharing program and partners with a car-sharing program [33].

UNM/MRCOG Travel Demand Study

A travel demand study by MRCOG is currently underway for the UNM/CNM area [3]. The study's focus is on travel demand strategies for UNM and CNM to achieve more efficient uses of transportation resources and is the source of some primary data used in this case study. TDM activities may include promoting alternative modes of transportation, de-incentivizing SOV utilization, and shifting trips from peak-hour congested corridors to off-peak periods. In addition to UNM and CNM, the City of Albuquerque and Bernalillo County are participating in this study.

Local Transportation Alternatives

UNM's Transportation Information Center is a new service offered by its Parking and Transportation Services (PATS) and is dedicated to promoting alternative transportation. UNM students, staff, and faculty can obtain a ABQ Ride Free Bus Pass Sticker at the kiosk, which is located in the Student Union Building, and can receive one-on-one trip-planning information (routes, schedules, times etc.) from the staff. Additionally, customers can learn about the other alternative transportation programs available at UNM, such as Zipcar, a rent-by-the-hour car-sharing service, carpooling, and bicycle lockers.

Transit

In FY 2010, ABQ Ride had 11.7M riders, a 39 percent increase from 2009. There are 10 routes that serve the UNM area (2 of which also serve CNM) and 1 additional route that serves CNM. Approximately 15 percent or 1.8 million riders are from UNM or CNM. The ABQ Ride Free Bus Pass Program began in 2007 for UNM students and was expanded to staff and faculty the following year, including UNM Hospital staff. The program allows members of the UNM community to travel on any ABQ Ride bus at any time for free, including the city's popular Rapid Ride buses. UNM's transit profile is shown in Table 5-2.

Table 5-2
Transit Profile at UNM

ABQ Ride Free Bus Pass	Unlimited access to ABQ Ride
Lobo Shuttle	LOBO shuttles to Main, South, and some parts of North campus; UNM Hospital operates its own system; no shuttle to the Rio Rancho campus
Other Transit Operators	ABQ Ride - City public transit; UNMH Shuttle serves staff and hospital visitors

The majority of UNM parking is located in remote, peripheral parking lots that are served by UNM's Lobo Shuttle. The shuttles circulate around Main Campus and to North Campus to the Law School and Health Sciences Center and to the Science and Technology Park on the South Campus. UNM also provides a daily shuttle to three NM Rail Runner trains (one inbound and two outbound). The Lobo Shuttle operates on very short headways without a fixed schedule in peak periods and carries more than 1.8 million riders annually and averages 8,000 to 10,000 riders a day. This makes Lobo Shuttle one of the state's highest ridership transit systems.

Bicycling and Car-Sharing

In a travel demand study conducted as a part of the UNM/MRCOG project, it was found that almost 10 percent of students and staff bicycle to campus. Nearly 70 percent of bicycling trips were between 1–5 miles (1.6 to 8.0 km) long, although a number of trips are made from distance of up to 10 miles (16.0 km). There are nearly 4,200 bikes on campus daily. Table 5-3 lists bicycle and car-sharing services.

Table 5-3
Bicycling and Car-Sharing, UNM

Area	Bicycling		Car Sharing Program
	Sharing/Rentals	*Repair Services*	
Sharing/rentals	Lobo bikes for departments		
Service fees		Yes	$8/hr, $64/day
Annual fee			$35

Carpooling

Carpooling activities are listed in Table 5-4 below.

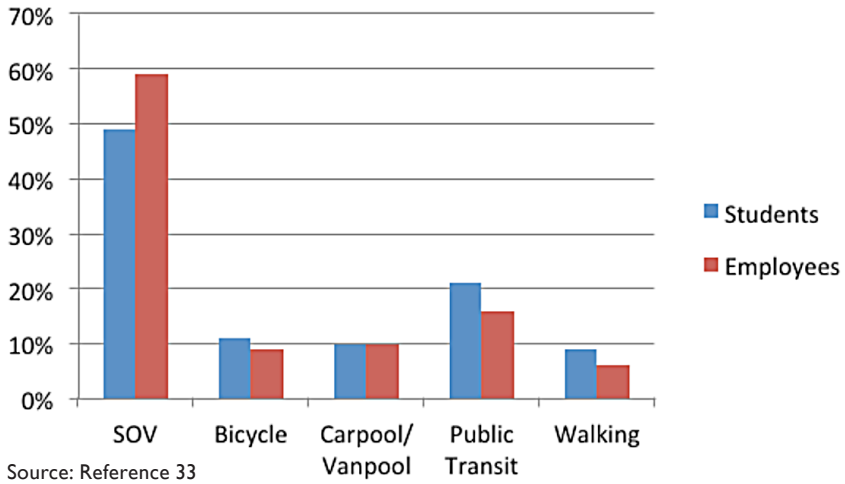
Table 5-4
Bicycling and Car-Sharing, UNM

Carpooling/vanpooling incentives	Students: Yes; Staff: Yes
Carpool/vanpool matching	AlterNetRides http://alternetrides.com/zz_home_ride.asp?location_key=57153812&width=1093&height=590
Ride matching	eRideShare.com

UNM Modal Split for Students and Employees

In general, student use of alternative transportation modes is higher than that of employees; 51 percent of students and 41 percent of employees use some form of alternative transportation. A further breakdown is displayed in Figure 5-1 and Table 5-5.

Figure 5-1
Modal Split, UNM



Source: Reference 33

Table 5-5
Modal Split, UNM

	SOV	Bicycle	Carpool/ Vanpool	Public Transit	Walking
Students	49%	11%	10%	21%	9%
Employees	59%	9%	10%	16%	6%

Source: Reference 33

Campus Motor Fleet

Alternative-fueled vehicles in UNM's campus fleet are summarized in Table 5-6.

Table 5-6
Campus Motor Fleet, UNM

Campus motor fleet	715
Type of alternative fuel	
100% electric	40
Fueled with B20 or higher	23
Gasoline-electric hybrid	1
CNG/E85/LPG	17
Total (%) alternative fuel vehicles	*81 (11%)*

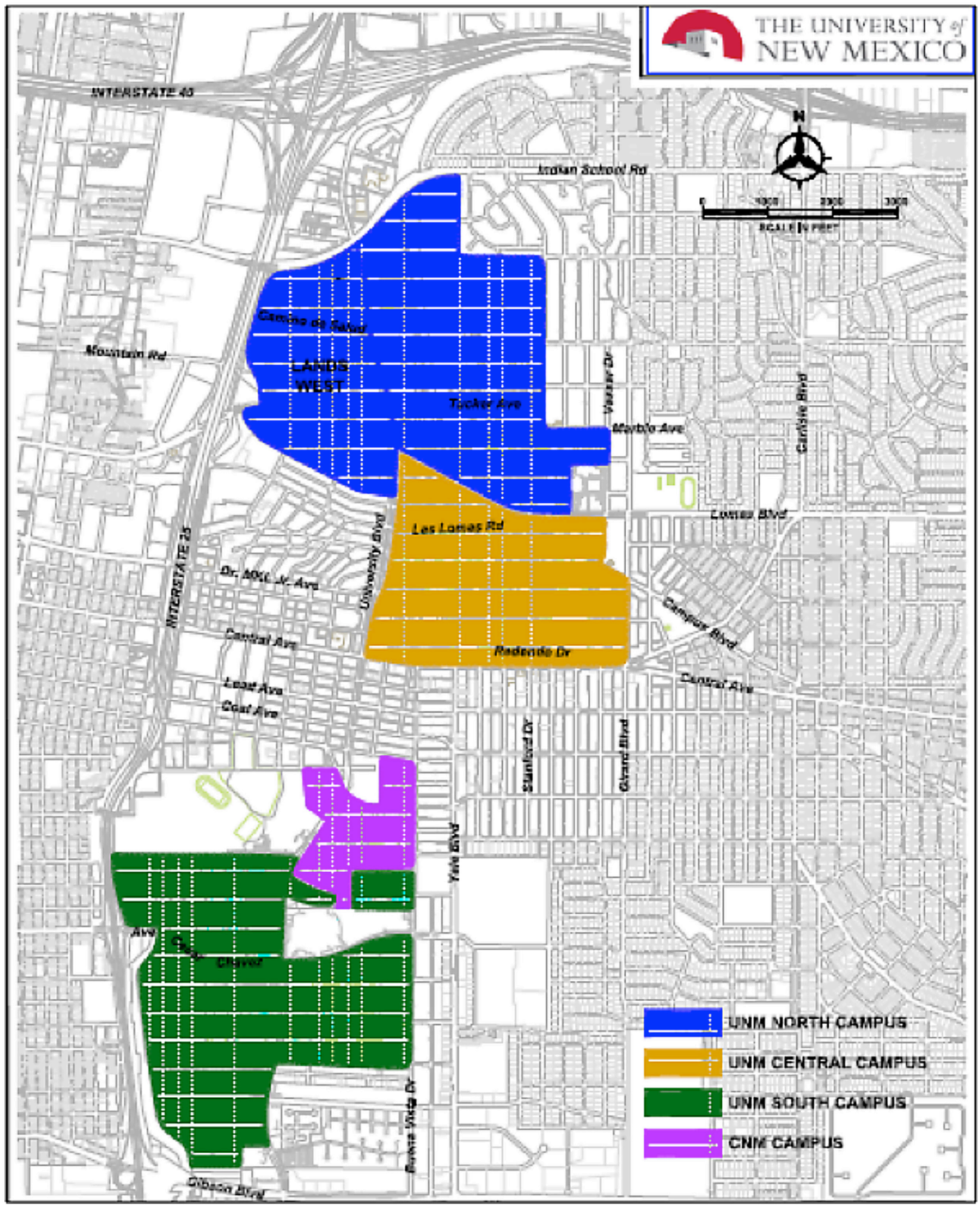
Existing Transportation Systems in the UNM Area

In addition to the information available from UNM websites and campus planning documents, the study team collected detailed information, as reported in the following paragraphs.

UNM and CNM are major transportation trip generators in the Albuquerque region. The three UNM campuses and the CNM Central campus are co-located within approximately two miles (3.2 km) of each other, as shown in Figure 5-2. Much of the parking provided by UNM and CNM is located along a two-mile stretch of University Boulevard. While parking at UNM is fee-based for both permits and meters, CNM provides 2,500 free parking spaces and has 1,400 spaces of paid parking, for which 2,400 permits are sold for $129 per year [41].

Figure 5-2

UNM and CNM campus locations



The coordination of transportation systems within the UNM/CNM area is a major concern that has a significant impact on the campuses as well as on the surrounding community. UNM is actively examining policy issues to identify its path forward to change demand for single occupancy vehicles. This goal is amplified in UNM's transportation and connectivity principles and themes in its recently adopted UNM's Consolidated Master Plan [5] for its three campuses. While faculty, staff, and students share many travel characteristics, each has different travel opportunities, limitations, and needs.

UNM intends to make transit the primary access to its campuses; this will serve also to reduce surface parking demand on each campus. According to the Plan, reducing parking

will enhance the campus environment by enabling infill development of more dynamic, education-based uses. A well-planned, convenient, and service-oriented transit network, in conjunction with the bike, parking, open space, and pedestrian strategies, will greatly improve connectivity between and within the campuses. [5]

Providing incentives and convenient accommodation of low-emission transportation options can substantially reduce transportation-related GHG emissions and help UNM achieve its goal to be carbon-neutral by 2030.

UNM and CNM Populations and Travel Distances

According to the recent MRCOG Travel Demand Study [3], UNM and CNM have 74,000 students and staff who come to, and travel within, their campuses daily. Additionally, UNM Hospital attracts about 1 million trips a year. MRCOG estimates that SOV travel demand is 1.3 million vehicle miles of travel (VMT) per day (2.1 million km) or 5.32 percent of the total VMT for the region. Congestion is already evident in the area, and the MRCOG traffic model shows that many streets in the area will be over capacity by 2015.

Demographic and socio-economic contributors to the number of trips taken to, and within, the campuses include:

- Large number of non-traditional, older students (married, working, part-time)
- Average student age 26.6 years
- Average UNM time to graduation 6.5 years
- Multi-nodal nature of the UNM campuses
- Total of 3,000 student articulation agreements between CNM and UNM (students taking classes at both institutions), resulting in additional trips

The MRCOG study shows that while concentrations of UNM and CNM populations live in nearby neighborhoods, a large portion of travel is from 6 or more miles (9.7 km) away and almost one-quarter of the trips are from more than 10 miles (16.0 km) away; all contribute to the high usage of SOVs to the campuses [3]. Travel distances, not unexpectedly, are a major factor in determining what travel mode is used as indicated in Table 5-7.

Figure 5-7

Distribution of Students and Faculty/ Staff by Distance from Destination, UNM

Distance from Destination	UNM Students (no dorms)	UNM Faculty/ Staff	UNMH	CNM	Total
1 mile (1.6 km)	5.5%	2.3%	1.3%	2.5%	3.4%
2 miles (3.2 km)	9.6%	10.4%	5.1%	3.6%	7.0%
3 miles (4.8 km)	7.3%	8.5%	5.6%	4.5%	6.3%
4 miles (6.4 km)	5.4%	4.7%	6.8%	5.1%	5.2%
5 miles (8.0 km)	5.8%	5.2%	7.1%	7.5%	6.5%
6 miles 9.7 km)	7.6%	6.7%	9.0%	9.0%	8.1%
7 miles (11.3 km)	10.8%	8.7%	10.5%	11.9%	10.8%
8 miles (12.9 km)	11.2%	9.1%	11.3%	11.6%	11.0%
9 miles (14.5 km)	10.5%	9.5%	9.9%	8.9%	9.6%
10 miles (16.1 km)	8.8%	7.0%	6.4%	6.1%	7.2%
Over 10 miles	17.5%	27.9%	26.9%	29.3%	24.8%

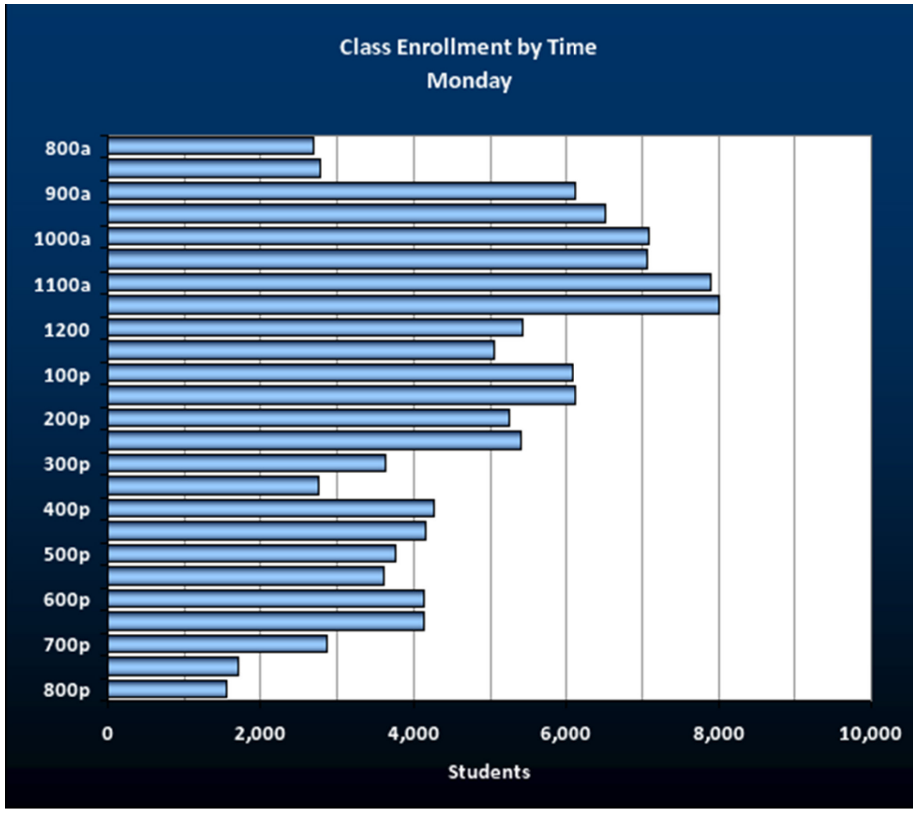
Source: Reference 41

Class Enrollment and Parking Lot Usage

Building utilization data and anecdotal information from the MRCOG Travel Demand Study [3] on parking lot usage show that travel to and from the UNM campus peaks on weekdays between 7:30–9:00 AM (the traditional AM peak) and between 2:30–4:00 PM (slightly before traditional PM peak). These patterns, as seen in Figure 5-3, reflect the hours that students attend classes on a Monday or Tuesday. Peak hours also reflect the times of the day that have the heaviest demand for parking. Many students also make multiple trips to campus, with weekday averages of about two trips per day per student to and from campus [42].

Figure 5-3

UNM Class Enrollment Times



Source: Reference 41

Travel Mode Split

To have a sustainable transportation system, there must be viable travel demand management strategies that promote and support alternative transportation modes. The UNM/MRCOG 2010 Travel Demand Study survey data, which included UNMH and UNM HSC, show that, as previously described in Figure 5-1 and Table 5.5, 51 percent of students and 41 percent of faculty and staff report using an alternative transportation mode to get to campus.

While students are more likely than faculty and staff to use alternative modes of transportation, the distance to be traveled is a strong influence on travel mode choice, as previously shown in Table 5-8. According to the MRCOG Travel Demand Study [3], more than 71 percent of those who travel 2 miles (3.2 km) or less report they are very likely to use an alternative mode of transportation to travel to and from UNM, and, as expected, the rates generally decline with distance. Of all the UNM populations who use alternative transportation, 33 percent use ABQ Ride to get to and from campus. Alternative mode shares decrease to 9 percent for "other" modes (which includes the Rail Runner, getting dropped off by a family member, and walking to a remote parking lot and taking the UNM shuttle). More than 70 percent of those who live more than 5 miles (8.0 km) away use SOVs. The effects of distance on travel mode are highlighted by data from a 2010 commuter survey of the UNM population described in Table 5-8.

Table 5-8

Distance between Home and UNM Main Campus by Primary Mode

Distance	Walk/ Skateboard	Bicycle	ABQ Ride	Drove Alone	Carpool	Other	NM Rail Runner	Total	Alternative Mode
1 mile (1.6 km)	51%	28%	2%	13%	1%	4%	1%	100%	87%
2 miles (3.2 km)	17%	28%	9%	29%	6%	10%	1%	100%	71%
3 miles (4.8 km)	3%	20%	18%	52%	6%	1%	0%	100%	48%
4 miles (6.4 km)	0%	9%	16%	53%	16%	7%	0%	100%	48%
5 miles (8.0 km)	0%	2%	20%	71%	5%	3%	0%	100%	30%
6 miles (9.7 km)	1%	3%	12%	73%	9%	1%	1%	100%	27%
7 miles (11.3km)	0%	0%	15%	76%	8%	0%	0%	100%	23%
8 miles (12.9km)	0%	1%	14%	75%	7%	3%	1%	100%	26%
9 miles (14.5km)	0%	2%	14%	72%	7%	4%	0%	100%	27%
10 miles (16.1km)	0%	2%	11%	78%	9%	0%	0%	100%	22%
10+ miles	0%	1%	26%	65%	5%	2%	1%	100%	35%

Top two primary modes by distance category are highlighted.
Source: Reference 41

TDM Efforts

In spite of an increasing student population, UNM has been successful in using TDM strategies, which has resulted in a reduction of SOV usage from 78 percent in 2004 to 49 percent in 2010. This reduction has occurred despite having no dedicated TDM staff in the PATS Department. A significant portion of the decrease is attributed to implementation of the free ABQ Ride transit access program in 2004, as well as increased parking fees, the increased price of gas, and greater environmental awareness. However, there is growing pressure to further reduce SOV usage, as surface parking will continue to decrease as UNM moves to transition from a commuter university to a sustainable urban, residential one. A significant strategy to accomplish this is by increasing on-campus housing.

In September 2011, UNM adopted its consolidated master plan, which focused on connectivity goals through a merged, unified transportation system among UNM's three campuses. A robust alternative transportation system is essential for continuing to reduce SOVs and meeting UNM's climate change goal to be carbon-neutral by 2030. A unified system is intended to make the UNM campuses more livable and sustainable by promoting alternative transportation systems through various TDM strategies [5].

An interim sustainability goal is to reduce UNM carbon footprint by 50 percent by 2020. This would be accomplished by reducing vehicle access to the Central Campus, increasing access to transit on all campuses and making Buena Vista Drive, currently a neighborhood street, a recognized pedestrian and bicycle route between the South and Central campuses.

Parking

UNM parking has been a much-studied problem starting with the Walker Parking Study in 2005, the UNM Strategic Transportation Plan completed in 2009, and, most recently, the parking goals contained in the 2011 Consolidated Master Plan. As UNM transitions from a commuter to a more residential university, and as new facilities continue to consume more land previously used for parking, available parking continues to decrease, thus reducing SOV use and increasing use of alternative transportation modes.

While many parking areas still exist at both UNM and CNM, demand outstrips available parking supply. Handicapped parking continues to be a problem. While the University has more than doubled the number of handicapped spaces that are required by the Americans with Disabilities Act (ADA), mobility-impaired individuals still have difficulty locating an accessible parking space close to main campus activities [2]. Current parking resources include those described in Table 5-9.

Table 5-9
Parking Resources, UNM

Area	UNM/UNMH	CNM
Parking lots	38 UNM student/faculty/staff lots (12,786 spaces, all paid) 7 UNMH lots (2,739 spaces, some paid)	8 general lots (2,500 spaces) 6 paid lots (1, 400 spaces)
Permits	About 14,000 sold annually	About 2,500 sold annually
Rates	$150 to $1,600 annually	$43/term; $129/year

Source: Reference 5

Various studies have concluded that UNM's parking model is outdated. Approximately 150 acres of UNM acreage at its 3 campuses is now devoted to parking. Many lots are located on developable land near academic, research, residential, and athletic facilities. With 3 UNM campuses, parking is complex, given that the Main Campus has only 2,836 spaces. Total spaces, including those controlled by other UNM entities, are shown in Table 5-10.

Table 5-10
UNM Parking Spaces by Location

Location	# Spaces
Managed by UNM PATS (surface and structure parking)	12,786
Hospital (North Campus)	2,739
Athletics (South Campus)	1,892
Continuing Education	248
Elk Lodge	285
UNMH Administration	448
Science & Technology Park (South Campus)	2,140
Total	*20,538*

Source: Reference 2

Many of these parking spaces are in remote locations, such as the South Lot located near University Stadium on the South Campus and the Q Lot between University Boulevard and the North Golf Course. Shuttles are used to provide rides from these parking lots to other areas on campus. UNM pays the Athletic Department for use of the South Lot, which has just over 4,000 spaces. Special event revenue from UNM athletic events is retained by Athletics [2].

Parking is also available at the Science and Technology Park (STC) on the South Campus. STC serves mostly private tenants, and parking is included in the building rent. STC has rooms available for meetings and conferences for up to 200 visitors and uses a free parking structure located at Basehart Road and University Boulevard. UNM Hospital Support Services uses 700 parking spaces on South Campus.

Even with more than 20,000 spaces, parking is not adequate to meet the current SOV parking demand. While estimates vary as to UNM's parking shortfall, changing travel modes has not yet been able to decrease parking demand sufficiently.

In 2010, with the planning of increased residential facilities on the Main Campus and its adverse impact on the parking supply, the Lobo Development Corporation prepared a Strategic Parking Proposal with several options [6]. Some on-campus dorms are being torn down and new dorms built on existing surface parking lots, for a net gain of 700 dorm beds to be available by August 2012. Eventually, there will be 4,000 additional beds and a projected 2,290 deficit in parking spaces without significant policy changes that focus on demand. This study, described later in this section, provides comprehensive data about UNM's parking and transportation environment as well as proposals for improving the campus transportation environment.

Parking Permits

Faculty and staff can purchase permits for lot locations on, or near, the Main Campus, and other commuters (students mostly) can buy park-and-ride permits in remote parking lots, some of which are more than a mile away from the Main Campus. Much of the UNM remote parking is accessed by shuttles, whereas all CNM parking is walk-up. Base price for a permit is similar for both institutions, although premium (reserved) permits and structure parking at UNM range up to $1,600 annually. Dormitory residents can park in surface parking lots or parking structures near their dormitory for a subsidized price comparable to faculty and staff rates. The permit rates for the current academic year are shown in Table 5-11. In addition to the rates shown in the table, motorcycle parking is available for $70 per year for motorcycles above 49cc; those that are 49cc and below are free.

Table 5-11
UNM Permit Rates, 2011–2012

Permit Type	Rate/Year
Commuter	
Park-and-ride (G, Q, South, Zia), all customers	$150
Surface lots	
Student (if eligible), Main/North campuses (T, M)	$210
Faculty, staff earning <$50,000	$400
Faculty, staff earning >$50,000	$475
Individual reserved	$1,300
Structure spaces	
Faculty, staff earning <$50,000	$499
Faculty, staff earning >$50,000	$698
Yale parking garage, student rate	$499
Individual reserved	$1,600
Department/vendor	
Surface, departmental reserved	$1,243
Structure, departmental reserved	$1,600
Departmental permit	$475
Vendor permit	$524
Resident – Dorm resident, Fall/Spring	$300

Source: Reference 45

UNM Consolidated Master Plan Parking Goals

An essential element in UNM's Consolidated Master Plan [5] is to reduce and limit vehicle access to core UNM campus areas by eliminating surface parking on the Main Campus and strategically restricting it on the North and South campuses. The goal is to make the campuses more pedestrian- and bicycle-friendly, reduce the number of parking lots, provide space for infill of future academic developments, and reduce UNM's carbon footprint. The key components of the Consolidated Master Plan parking goals are included in Table 5-12.

Table 5-12
Consolidated Master Plan Parking Goals

Area	Goal
Parking Cap	Cap the amount of parking on the Central Campus and consolidate the parking on the North and South Campuses to balance transportation demands.
Replacement Fee Policy	Establish a policy where new facility development costs include replacement fees for any lost parking spaces. Fees for lost parking spaces will be applied to costs associated with construction of structure parking.
Structure Parking	Develop structure parking in association with new development. Most of the parking will be short-term in nature, and the structure will be strategically located to serve visitors to multiple facilities.
Wayfinding	Coordinate the location, look, and message of directional and informational signage related to parking policies and availability.
Financial Incentives	Create strong financial incentives for students, faculty and staff to use remote parking.
Incentives for Alternate Forms of Transportation	
Park and Ride	Explore the purchase of sites for Park & Ride services along major streets

Source: Reference 5

PATS Operations

PATS is responsible for all parking and transportation issues on the UNM campus and is self-funded through the issuance of parking permits for students, staff, and faculty for all three campuses as well as from fees relating to enforcement of parking regulations. Parking permit fees, metered parking revenue, hourly payments at parking structures, special event parking, and parking fines are the only sources of revenue for PATS; the department receives no funding from tuition, student fees or State allocations. According to the UNM Consolidated Master Plan, this model is neither sustainable nor financially-effective because, as parking spaces are eliminated, revenue will obviously decrease.

In Fall 2011, the UNM Board of Regents approved the first parking permit increase since 2008. The intent of the increased fees was to fund parking lot development and maintenance, debt service for the new Yale Parking Structure, investments in alternative transportation, expansion of shuttle services due to enrollment growth, increases in fuel costs and usage, and shuttle replacement [43].

PATS has a $6.5 million operating budget with a staff of 83 FTEs, including enforcement staff, 30–33 bus drivers, 2 service technicians, and 4 supervisors. There are no student drivers since the minimum requirement is a commercial driver's license and six months' experience.

TDM programs initiated by PATS since 2006 are summarized in Appendix C.

Zipcar

UNM has a contract with Zipcar, a national car-sharing service, which enables students, staff, and faculty to rent a car at minimal cost. This vehicle-sharing service is available nationwide for members of the program. UNM students age 18+ can join and use the on-campus Zipcars when they are available. This program provides students, faculty, and staff the option to not own a vehicle or to use alternative transportation modes to get to campus while still allowing access to a vehicle for emergencies, errands, or other short-term travel needs.

Currently, UNM has five Zipcars available. The hourly rate is $8, with a $64 rate for an entire weekday. On the weekend, the hourly rate is $9, or $72 for the whole day. This fee includes gas, vehicle insurance, maintenance, and 24/7 roadside and customer assistance. The vehicles can be reserved on-line or by phone. Dormitory resident assistants (RAs) can have the $35 membership fee waived and also receive a $50 bonus for every student they enroll in the Zipcar program.

Carpooling

Nearly 10 percent of UNM students and staff carpool to UNM. The PATS carpooling program is intended to help lessen demand for parking and reduce congestion on streets. UNM works with a free rideshare program, AlterNetRide, which puts subscribers in touch with each other. The program is currently only for faculty and staff. Benefits offered to carpoolers include a reserved parking space and reduced parking costs by allowing 2 to 8 people to share one parking permit [46].

Guaranteed Ride Home

The City of Albuquerque offers a free Guaranteed Ride Home program for registered UNM commuters who use alternative transportation at least three times per week. This service is available if a bus connection is missed or if there is an emergency. The program can provide a ride to a person's home anywhere within the ABQ Ride service area. Members can receive up to five rides per calendar year.

Transit Systems

Transit is the essential component for a sustainable transportation system. At UNM, 21 percent of students and 16 percent of employees use transit to travel to and from campus. On the other hand, CNM transit usage is only 8 percent.

ABQ Ride, the City-operated transit system, provides a free access program to both UNM and CNM faculty, staff, and students, and UNM's Lobo shuttle provides free transit services from outlying parking areas (mostly at South Campus locations) as well as intra-campus service. The North Campus operates its shuttle system independently and is primarily for hospital visitors. The Rio Rancho campus, 18 miles (29.0 km) west of the Main Campus, has no shuttle service. CNM does not operate a shuttle service although their students may be riding on UNM-operated shuttles.

UNM Consolidated Master Plan Transit Goals

The main goal for transit in the Consolidated Master Plan is to make transit the primary mode of accessing UNM, with a secondary goal of reducing surface parking demand on all three UNM campuses. To achieve this, the Plan includes a Transit and Connectivity Policy that includes:

- Shuttles—a key component to UNM's Connectivity Policy is to restrict vehicular traffic access to the Main Campus and limit Redondo Drive to pedestrians, bicyclists, and maintenance vehicles. Shuttle service is essential to connectivity among campuses and must be coordinated with other UNM circulation systems, as well as with City transit. North and South campuses will be challenges for anticipated growth and increased density.
- City buses—ABQ Ride connections with the Central Campus have remained essentially unchanged since the 1996 Master Plan and provide good access to the Central Campus. The frequency and redundancy of ABQ Ride needs to be continually fine-tuned.
- People mover—the intention of this concept is to have a dedicated corridor along Yale Boulevard for future development. While transit is not defined yet, increasing urban growth around UNM sustainable connectivity will be a demand [5].

ABQ Ride Bus Routes

The UNM area is one of the better-served parts of the city, primarily because of the premium and high-frequency service operated along Central Avenue, including the Rapid Ride transit service. Many bus stops are located on the perimeter of the UNM Main Campus, and the Central Avenue bus routes are approximately ½ mile from most CNM destination, beyond comfortable walking distance for most pedestrians. Other CNM bus connections are few and inconvenient.

Based on the UNM survey data in the MRCOG TDM Study and an analysis of UNM and CNM parking permit holders and ridership data, bus routes that are direct and have short headways are the most popular with UNM/CNM riders, although CNM currently has no direct or short headway routes. The ABQ Ride free access program, funded by UNM, the City, and Bernalillo County, provides incentives for students, faculty, and staff to ride transit. On-campus

parking policies and marketing efforts by UNM, CNM, and ABQ Ride also contribute to high ridership levels [3]. Google now offers transit and walking trip planners at [47].

Direct and rapid transit connections are the most successful at attracting riders. The limited direct routes to CNM greatly reduce transit's ability to be a primary mode of transportation to the institution. CNM's access rate of only 8% this poor service.

Overall, including commuter routes that operate only at peak hours, a total of 10 routes serve UNM, as shown in Table 5-13. This service includes operations on three sides of the campus, including premium service (ABQ Ride's Red, Blue, and Green lines) with short headways and long hours of operation. In comparison, only three routes serve CNM; these are characterized by long headways, shorter hours, and limited geographic coverage and are shown in Table 5-14. Figure 5-4 is a map of ABQ Ride UNM/CNM routes.

Table 5-13

5-13 UNM–ABQ Ride Bus Routes

Route	Street	Peak Headway (mins)	Mid day Headway (mins)	Span of Service	
				Start	*End*
5	Lomas/Montgomery	25	25	6:05 AM	9:35 PM
11	Lomas	20	20	6:19 AM	5:39 PM
16/18*	CBD/Gibson Circulator	45	45	6:19 AM	5:39 PM
50	MLK/Yale	30	30	6:47 AM	8:13 PM
66	Central	15	15	6:00 AM	10:25 PM
766**	Central/Uptown	15	15	5:40 AM	9:00 PM
777**	Central/Tramway	15	15	5:50 AM	9:10 PM
790**	Coors/Lomas	7–15	20	6:15 AM	9:49 PM

*Headways in excess of 30 minutes
** Premium routes
Source: Reference 2

Table 5-14

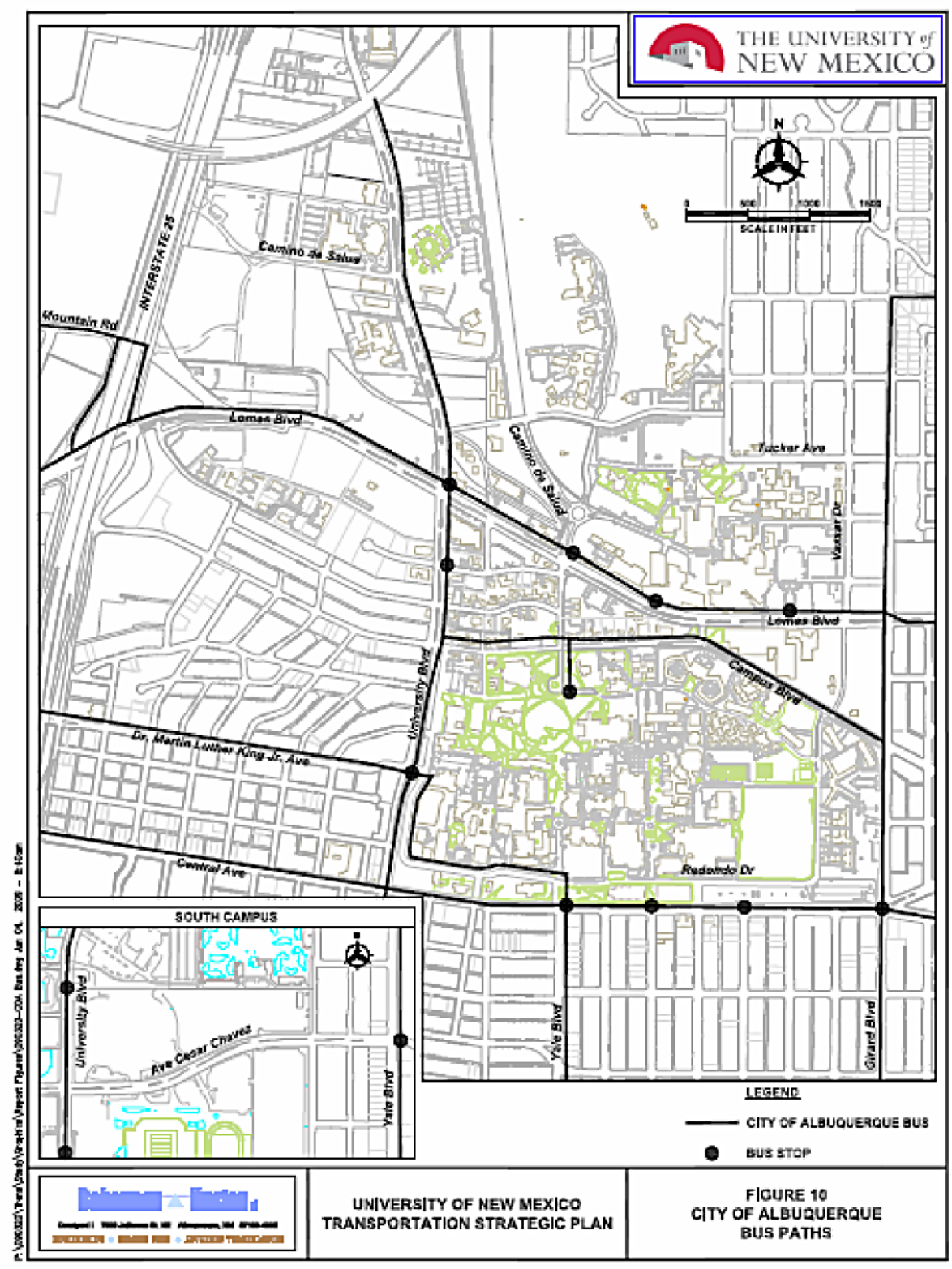
CNM–ABQ Ride Bus Routes

Route	Street	Peak Headway (mins)	Mid day Headway (mins)	Span of Service	
				Start	*End*
16/18*	CBD/Gibson Circulator	45	45	6:19 AM	5:39 PM
50	MLK/Yale	30	30	6:47 AM	8:13 PM
97*	Lead/Coal/Zuni	60	60	6:14 AM	6:44 PM

*Headways in excess of 30 minutes
Source: Reference 2

Figure 5-4

UNM/CNM–ABQ Ride Bus Route Map

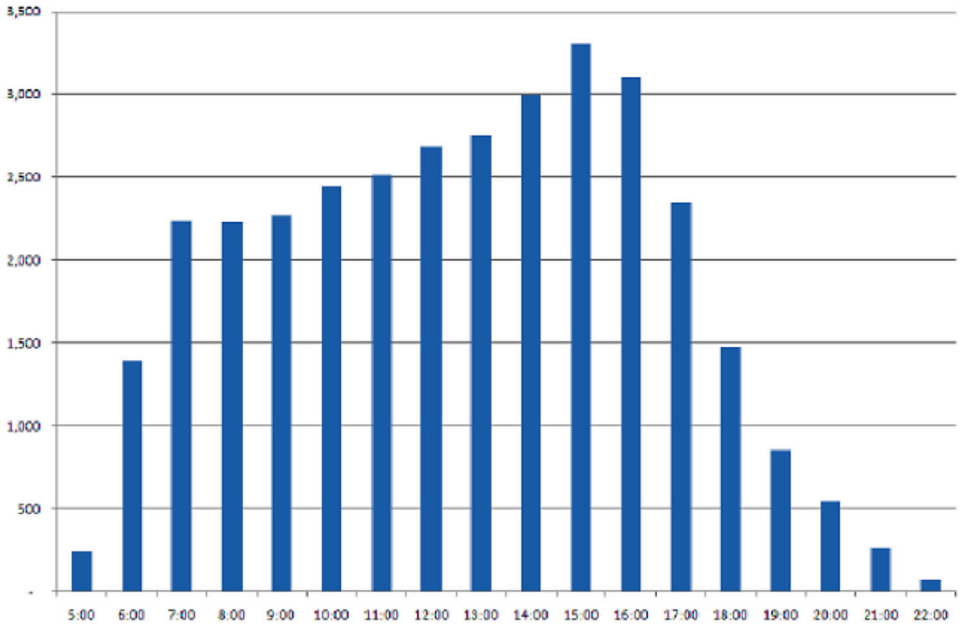


ABQ Ride Free Access

Since 2007, UNM has partnered with ABQ Ride to offer UNM faculty, staff and students free rides. For the Fall 2011 semester, PATS distributed 14,000 free ABQ Ride stickers. UNM and CNM passengers represented about 15.4 percent of total ABQ Ride ridership in 2010, with an average monthly ridership of 73,452 for UNM and 69,860 for CNM. While not used exclusively for travel to and from the institutions, there were 1.7 million UNM and CNM trips on ABQ Ride in 2010, a significant 39 percent increase from 2009, with no change in service or policies. Typical breakdowns of UNM/CNM free pass rides by hour of the day are shown in Figure 5-5.

Figure 5-5

Daily UNM/ CNM–ABQ Ride Riders by Hour of Service



Source: Reference 41

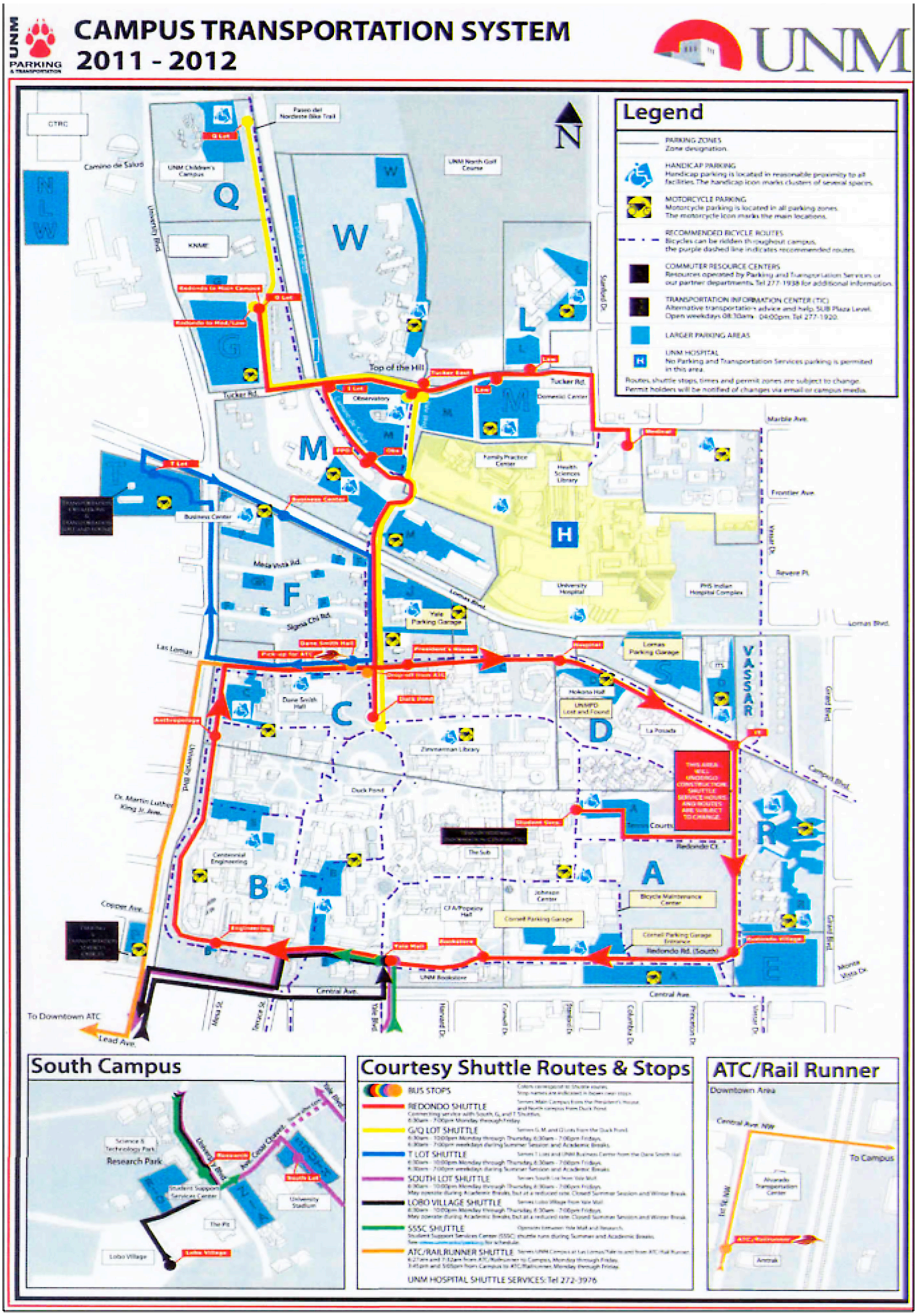
UNM's funding share of ABQ Ride free access costs is estimated to be less than 10 cents per ride; ABQ Ride obviously needs more financial support for the service it provides to both UNM and CNM. UNM funding for the program consists of $50,000 from student fees, $35,000 from Main Campus funds, and $15,000 from the North Campus.

UNM-Operated Transit Service

Two separate transit operations provide shuttle transportation for students, faculty, and staff—UNM PATS serves primarily faculty, staff and students, and UNMH transportation serves staff, visitors, and patients from parking lots to the hospital or other nearby UNMH medical services. There are no restrictions on who can ride either of these no-fare systems. Unfortunately, there is no coordination between these two transit operators regarding administration, service planning, maintenance, staffing, or training. UNM PATS does, however, perform enforcement activities for both transit systems. Figure 5-7 shows UNM's shuttle routes. UNMH shuttle routes are shown later in Figure 5-10.

Figure 5-6

UNM Shuttle Route Map



Source: Reference 41

Lobo Shuttle

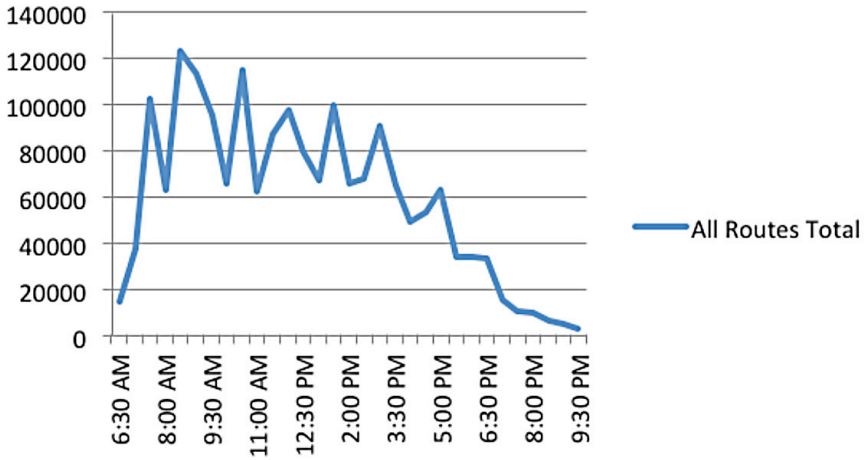
PATS operates the LOBO shuttle fleet, the larger of the two systems, with 30 vehicles, serving nearly 1.83 million boardings each year. There are 14 shuttle buses in operation on 6 routes, shown in Figure 5-6. Shuttle rides are free of charge.

The MRCOG study describes the LOBO shuttle buses routes as carrying passengers between remote parking lots and a variety of destinations on the campuses. The shuttles travel primarily north and south along Yale and University Boulevards. The South lot shuttle crosses Central Avenue, a key ABQ Ride corridor, and continues past CNM to the south parking lots with no intermediate stops. Other routes include the C/Q Lot Shuttles, the T Lot Shuttle, the Lobo Village Shuttle, and one morning and two afternoon shuttles to the Downtown Alvarado Transportation Center (ATC), a multi-modal transit hub which is a stop for many City bus lines (ABQ Ride), the NM Rail Runner train service, NM Park-and-Ride, and Amtrak. The ATC Shuttle morning schedule was reduced in October 2012 from two runs to one because of underutilization on an early (6:30 AM) run. The system also includes the Redondo shuttle, two buses circulating around Main Campus and north to the Law School and Health Sciences Center. The shuttles operate on very short, non-uniform headways in peak periods and carry 8,000–10,000 riders per day.

Ridership on the LOBO shuttles varies according to scheduled classes, the size of the lot, and the proximity to campus. In 2010, total yearly ridership was 1,832,986, with the lowest weekly ridership (not counting the holidays in December) of 4,570 occurring just prior to the start of the Fall semester (from August 16–20). The highest weekly ridership of 66,012 occurred the following week of August 23–27, coinciding with the start of the semester. Figures 5-7 and 5-8 show the cumulative ridership for all routes by time of day. Appendix D includes more detailed data on each shuttle schedule, and Appendix E provides individual route breakdowns.

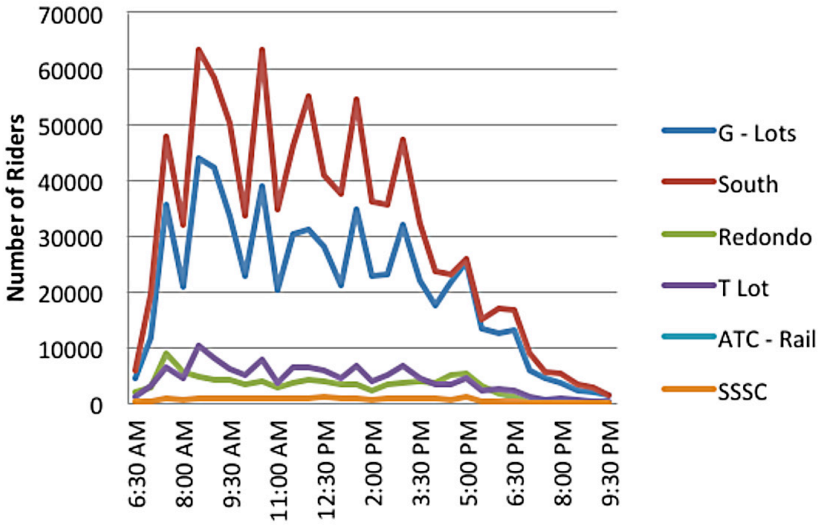
Figure 5-7

Lobo Shuttle Ridership, All Routes



Source: Reference 48

Figure 5-8
Lobo Shuttles Ridership by Route



Missing from the graph in Figure 5-8 are the three one-way shuttles (one morning, two afternoon) from/to the ATC/NM Rail Runner connection in downtown Albuquerque. A total of 6,630 one-way trips were made on these routes in 2010, an average of only 27 per workday.

The variance in distance traveled from each remote lot to campus and the frequency of services is reflected in the vehicle miles driven by shuttle buses during the 2010–2011 academic year; these totals are shown by route in Table 5-15.

Table 5-15
Lobo Shuttle VMT, 2010

Route	Vehicle Miles Traveled	Kilometers
ATC	12,552.4	20,201.1
G/Q Lots	54, 711.7	88,049.9
Redondo	38.511.3	61,977.9
South	108,164.9	174,075.0
SSSC	2,399.3	3,861.3
T Lot	15,650.4	25,186.9
Total	231,990.4	373,352.3

Source: Reference 48

UNM Lobo shuttle service was expanded in 2011 to serve Lobo Village, which recently opened on the South Campus with housing units for 864 students and faculty. This housing complex is about two miles (3.2 km) from UNM's Main campus and is served by three UNM shuttles. UNM parking permits are required to be purchased for Lobo Village, but efforts are being made to strengthen bike paths to Main Campus. UNM also is beginning to develop other clustered, mixed-use areas on the South Campus.

PATS takes advantage of technologies that reduce carbon emissions from its shuttle buses, as all new shuttle buses run on a bio-diesel blend. Recently, PATS completed work on its "Veggie Bus," a shuttle bus powered by disposed (waste) vegetable oil (WVO) from UNM's kitchens. This program is intended to show the feasibility of a completely self-sufficient, sustainable, on-campus transportation resource. The UNM shuttle fleet has 24 vehicles using alternative fuels: 11 diesel, 12 CNG, and 1 WVO. Most buses have a capacity of 70 passengers.

There is 12-year replacement schedule for the UNM shuttle fleet, with a current average bus age of 7 years and with 2 buses that are overdue to be replaced. Financing is a problem in replacing aging buses, as federal or State funds cannot be used to purchase new ones. PATS hopes that with the recent increase in parking permit fees, funds will be available to purchase new vehicles.

Currently, UNM shuttle ridership counts are performed manually by bus drivers, and "overfull" riders often are not counted. Desirable ITS technologies, such as APC systems to obtain boarding and alighting data, have not been employed because of funding issues.

UNM Hospital Shuttle Services

The UNM Hospital complex on the North Campus faces the same dilemma as the Central Campus, in that the construction of new buildings, the resulting reduced surface parking, and the need to reduce SOV use are decreasing the supply of available parking spaces at a time when UNMH is exhibiting significant growth.

The transportation needs of the patients, faculty, staff, and students using hospital services are currently being met by a fleet of 14 lift-equipped vans, 7 of which are in operation at any one time. The routes, which operate from 4:30 AM to 11:30 PM Monday through Friday, serve a total of 12 designated stops and provide on-call service to 4 additional locations, and operate on an approximately 15-minute headway, which could be substantially longer during peak periods [2].

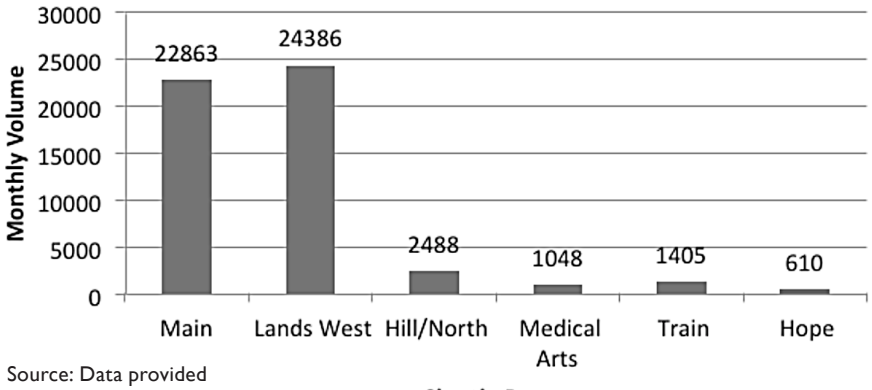
Two larger vehicles—44-passenger school buses—operate during the peak hours of 6:00–9:00 AM and 3:00–7:30 PM to transport hospital employees to/from the Lands West remote parking lot, and 3 daily round trips are made from the hospital to the ATC in downtown Albuquerque to provide a connection to the Rail Runner commuter rail service. A common complaint of hospital staff is the headway between shuttles and the inconvenience of having to be shuttled from remote lots. As with the main campus shuttles, there are no restrictions on who can use any of the hospital shuttles, and there is anecdotal information that some hospital patients are using the Rail Runner and its shuttle connection.

The only fixed routes are the scheduled train runs and scheduled runs to the hospital's HR building, located at 933 Bradbury on the South Campus (shown on Figure 5-9 as HOPE). The on-demand routes require that riders call a dispatch line and request a ride from point A to point B.

Estimates are that approximately 750,000 one-way trips are provided each year by the shuttles; current data from December 2011 (a slow month because of the holidays) show that more than 44,000 one-way trips were made on the 6 hospital shuttle routes, an average of 2,330 one-way trips per day.

A breakdown of more recent, and more typical for the January 2012 data is shown by route in Figure 5-9. Almost 90 percent of the 52,800 trips made during the month were along the hospital's main north/south and east/west spines of University Boulevard and either Camino de Salud (the Lands West remote parking area), Tucker Boulevard, or Lomas Boulevard. Of particular interest are the approximately 70 daily one-way trips made from the hospital area to the NM Rail Runner train connection at the ATC in downtown Albuquerque.

Figure 5-9
North Campus Shuttle Volumes



Source: Data provided by UNMH Shuttle Services

In addition to the shuttle services described above, the UNM Hospital complex on North Campus also operates golf carts, which carried an average of 300 patients and hospital visitors per day from parking areas to the hospital doors. The hospital also has a valet service that parks about 30 visitor cars per day. UNMH shuttle routes are shown in Figure 5-10.

Consolidated Master Plan Goals Relating to UNMH

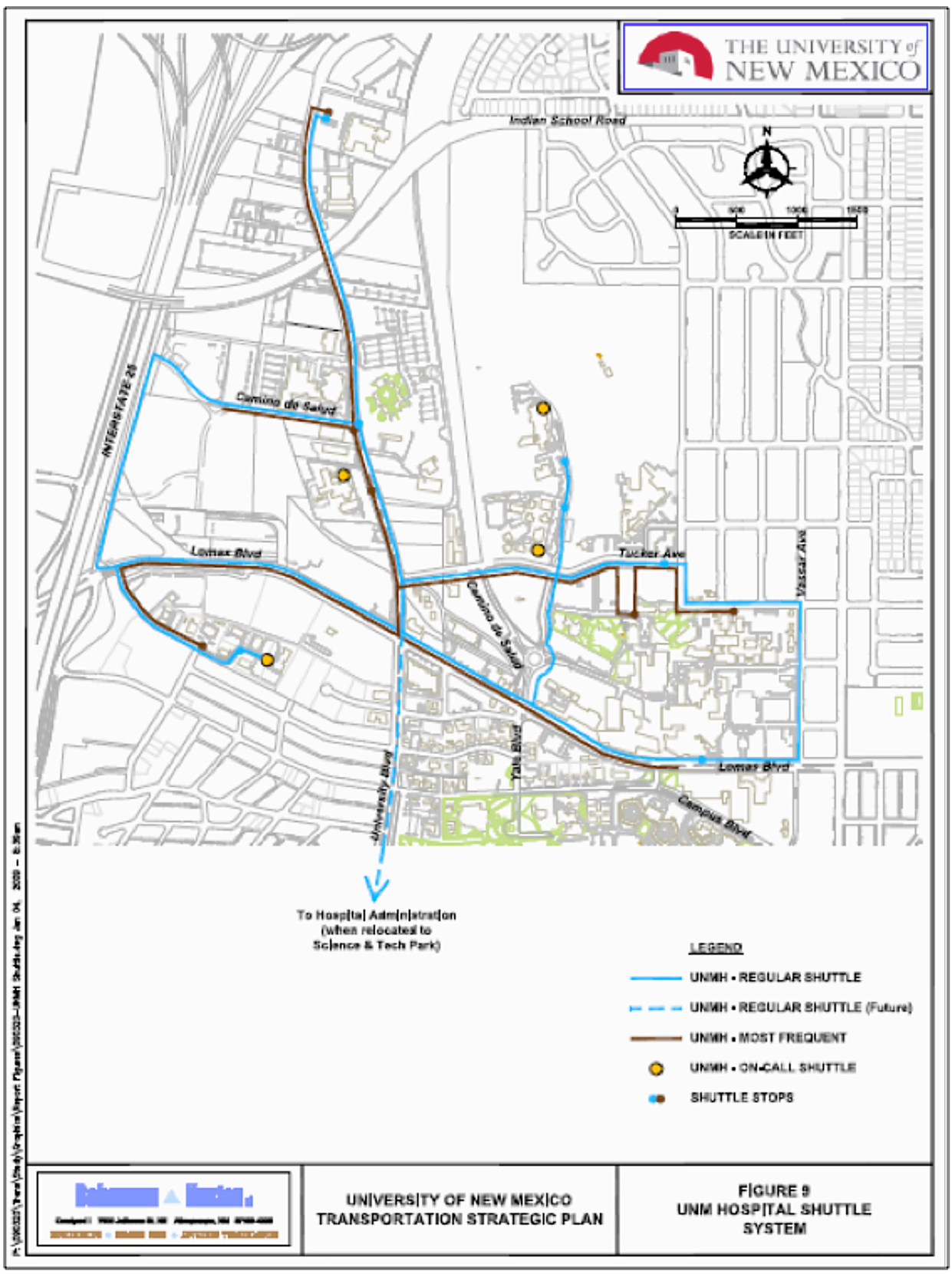
In the Consolidated Master Plan, accessibility and connectivity are two major goals for linking the east and west sides of HSC with dedicated transit and open space [5]. The UNM HSC has as its goal to reduce its parking inventory by 30 percent on the North Campus over the next 20 years. Strategies to achieve this goal include:

- Provide convenient campus transit for faculty, staff, and students that connect with other UNM campuses and ties into Albuquerque's Rapid Ride network.

- Limit vehicular traffic in the campus core to transit-only, encouraging the use of the shuttle and the parking structure network.
- Provide logically-located transit stops so that every facility on campus can be reasonably reached by a three-minute walk.
- Place parking structures at the perimeter of the campus and create high-visibility hubs.
- Prioritize surface parking for clinic and hospital patient use.

Figure 5-10

UNMH Shuttle Route Map



Source: Reference 2, p. 16

Bicycle and Pedestrian Facilities

Bicycle and pedestrian access at UNM is provided through a mixture of pedestrian pathways, sidewalks, open space, and service roads throughout its three campuses. The UNM Consolidated Master Plan focuses on connectivity as one of its principles, particularly relating to bicycle and pedestrian circulation issues.

Bicycling and Walking

The 2011 UNM Travel Survey indicates that approximately 10 percent of students, faculty, and staff bicycled to campus. Table 5-16 includes bicycling and walking mode splits and shows a 16 percent increase in use of these modes between 2010 and 2011. While biking is a popular mode for short trips (almost 70% were between 1 [1.6 km] and 5 miles [8.0 km] in length), a number of trips are also from distances of up to 10 miles (16.0 km). Throughout the campus, bicycles share routes with other vehicles and pedestrians; there are no dedicated bike lanes [41].

Table 5-16

Bicycling and Walking Modal Splits, UNM

	Bicycle		Walking		Total	
	2010	2011	2010	2011	2010	2012
Students	10.0%	10.6%	8.4%	8.0%	18.4%	18.6%
Faculty	7.5%	14.7%	4.8	6.3%	12.3%	21.0%
Staff	5.1%	7.1%	2.7%	6.4%	7.8%	13.1%
Total	8.4%	9.9%	6.5%	7.4%	14.9%	17.3%

Source: Reference 44

On any given day, there are 4,200 bicycles on campus. In 2009, there were racks for 2,023 bicycles in 166 locations; there were also 59 lockers available at various locations. Bicycles are managed by the UNM Police Department, which will engrave identification on bicycles as well as enforce regulations [2]. PATS also operates Lobo Bike, which is successful but does not have the funding to grow.

The PATS bicycling program "Bike It" provides information about bike safety, city bike trails, and bicycle advocacy. The program is dedicated to integrating cycling as an important part of an on-and off-campus alternative transportation option, since it is a healthy and sustainable alternative to SOV's. The "Bike It" website (http://pats.unm.edu/bike_it.cfm) provides links to register bicycles. Statistics show that the number of bicycle thefts is decreasing on campus. In 2006, there were 142 bicycles reported stolen, decreasing to 48 in 2008.

Free bike racks are located throughout campus and a secure bike park is located near Carlisle Gym (adjacent to the Yale Mall shuttle stop). Alternatively, a limited number of bicycle lockers is available for $24 for 6 months or $48 for 12 months. PATS maintains a bike map indicating the location of bike lockers and racks. Motorized scooters under 50cc are treated as bicycles and do not require a permit and may be legally parked at any bike rack.

The Bicycle Maintenance Shop located in Johnson Center is a complete bicycle repair facility, servicing all makes of bicycles and non-motorized wheelchairs. In addition to renting bikes, the Bike Shop provides maintenance, safety, spares, and repairs as well as information on biking. Fees are charged. A You Tube video is available on the PATS website on how to inspect a bike.

PATS also manages the LOBO Bike program in which 11 departments are selected by lottery to be given bikes for a given period of time that can used for intercampus trips such as for meetings, running errands, or exercising. This program is successful, but the demand cannot be met because there is a lack of funding to grow.

PATS is exploring having a bike-share program and is seeking sponsors for purchasing kiosks and bicycles. The first year cost would be $353,000 for 9 stations and 46 bicycles. The ongoing operational costs are estimated to be $60,000. With the expansion of on-campus housing and the possible influx of 2,000 students, alternative transportation modes are required. With this first step, the City might be interested in expanding a bike-share program beyond UNM.

Bicycling Master Plan

Improvements in bicycle path connectivity and circulation networks are primary focuses of current master plans. Adding more bicycle lanes to streets surrounding UNM should be coupled with more bicycle racks and lockers, painted signage and demarcation on roads and shared paths, specific speed and warning signs, curb cuts, removal of barriers, and lights in alternative path construction. Specific recommendations for improvements in connectivity are shown in Figure 5-11.

The Consolidated Master Plan incorporates goals from the 2009 UNM Bicycle Master Plan [49] and include:

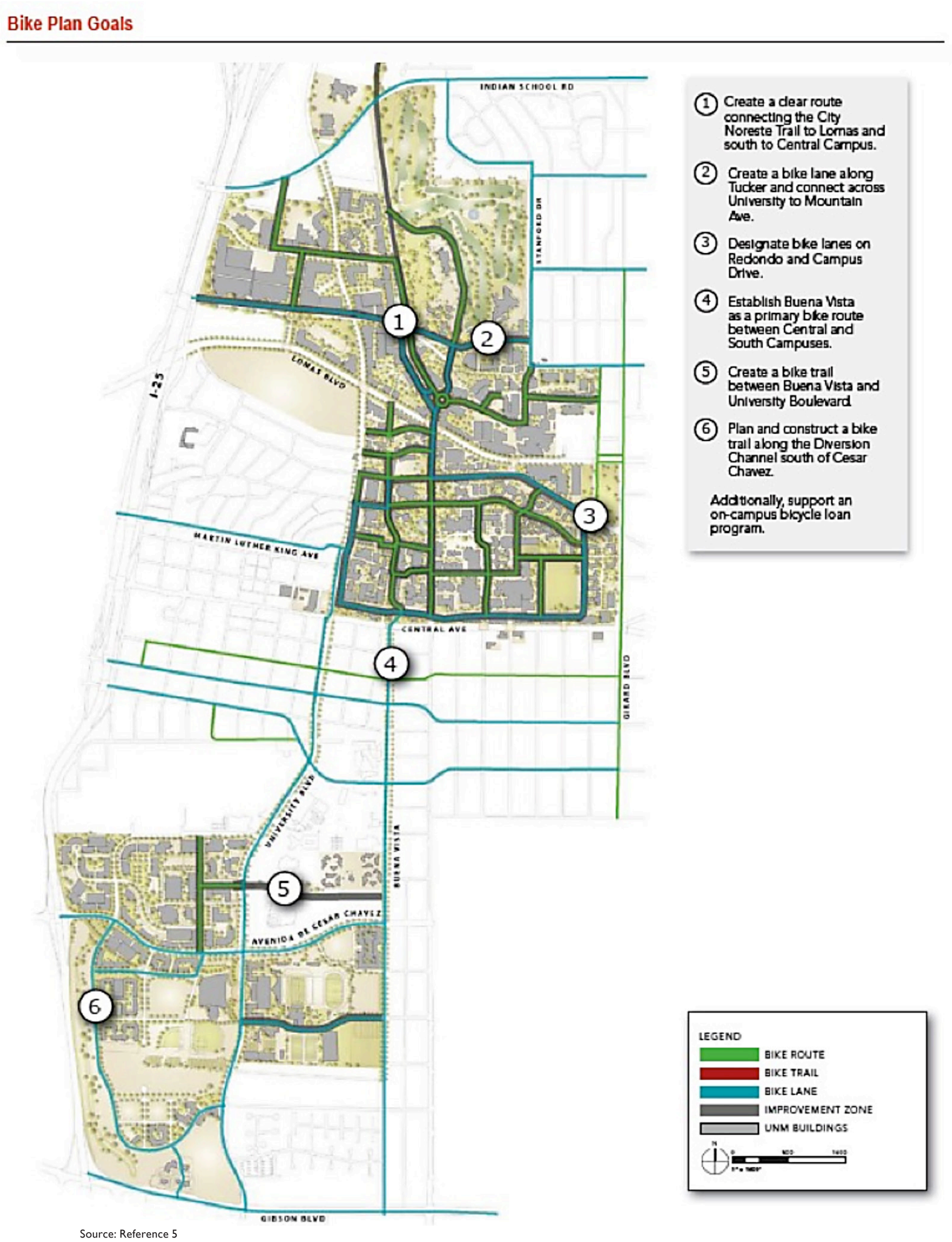
- Reducing vehicular travel by promoting alternative modes including bicycles.
- Providing secure bicycle parking and storage facilities located close to buildings.
- Providing conveniently-located shower and locker facilities for bicyclists.
- Providing additional curb cuts and eliminating barriers for bicyclists.
- Providing separation of bicyclists from vehicles and pedestrians where possible.
- Promoting an on-campus bicycle loan program.
- Encouraging City of Albuquerque bicycle lane and trail improvement connecting to UNM.

Also included in the Plan are Campus Design Principles for prioritizing pedestrian and bicycle networks that guide future growth, the placement of buildings, and the connection of all three campuses. They include:

- Strengthen the east-west pedestrian link from the northeast side of the Central Campus through to University Boulevard on the west.
- Improve the pedestrian zone along Lomas, Central, and University corridors.
- Establish Buena Vista Boulevard as a bike route.
- Improve at-grade crossings at major intersections.
- Clearly define and demarcate bike circulation from pedestrian circulation.
- Create more green space with shade areas.
- Establish Redondo Drive on the Central Campus as a bike route.

Figure 5-11

Consolidated Master Plan Bike Plan Goals



Source: Reference 5

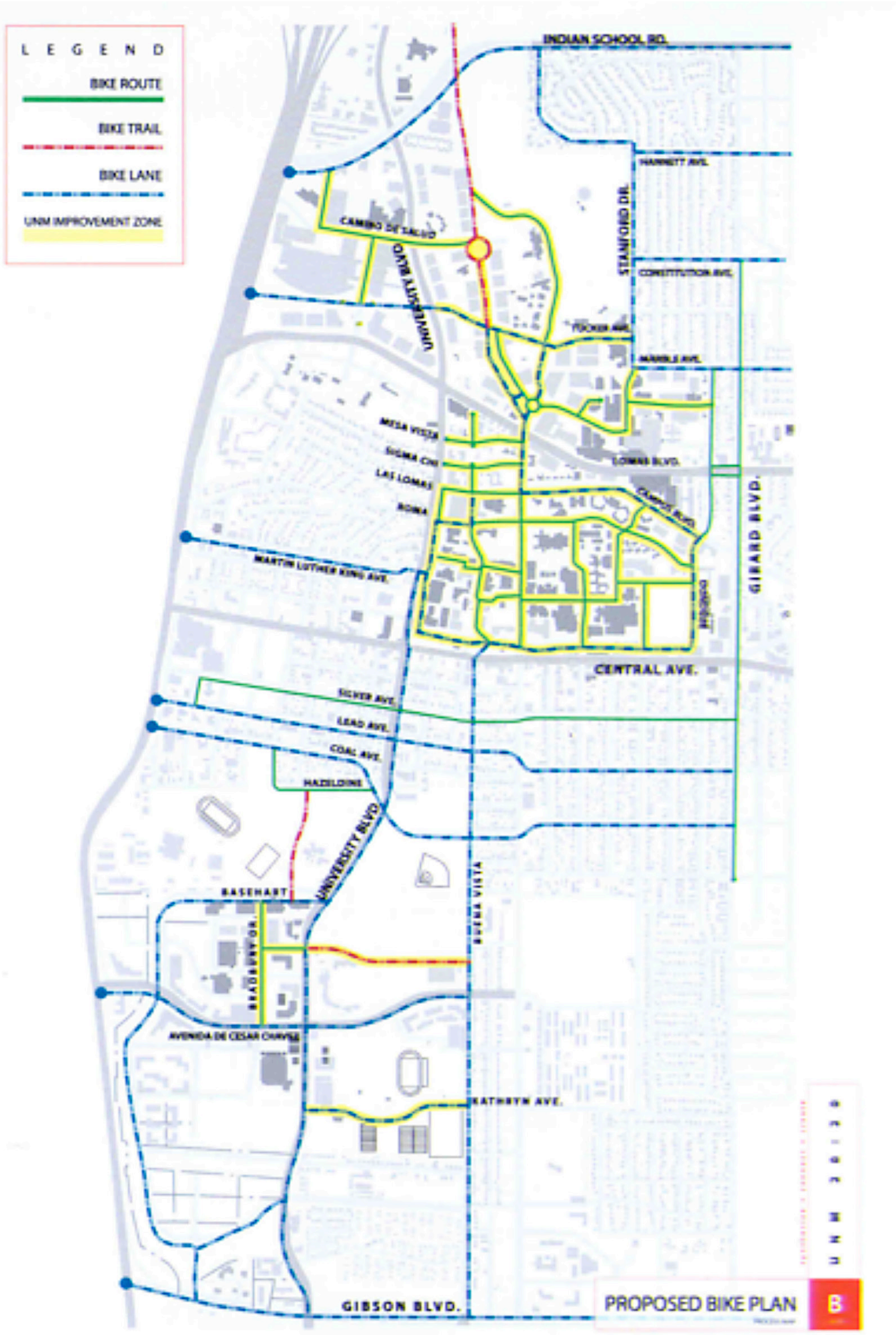
Existing Bike Routes External to Campus

The UNM Strategic Transportation Master Plan [2] describes major bike routes in the UNM area. While there is limited connectivity with existing city bike trails and paths, there is a major north-south bicycle trail from the North Campus to the northeast heights along the North Diversion Channel. The trail begins at Paseo del Norte and ends at Tucker on the North Campus. From Tucker, bicycles can use the road and parking lot on the south side of the Channel. There is a multi-use path on the west side of Yale Boulevard for a short distance between Camino de Salud and Lomas; bicycles may also share the road with vehicles.

The Plan call for east-west bicycle routes in the area include Silver Avenue, two blocks south of Central Avenue, Las Lomas–Campus Boulevard, and Dr. Martin Luther King, Jr. and Avenida Cesar Chavez. North-south bicycle routes include Stanford-Marble-Princeton east of the North Campus and Yale south of the Central Campus. There are bicycle lanes striped on Lead and Coal, except for a few areas where there is on-street parking and on University Boulevard south of Avenida Cesar Chavez. The proposed plan is shown in Figure 5-12. Contours showing the geographic areas within bicycling time categories for UNM are shown in Figure 5-13.

Figure 5-12

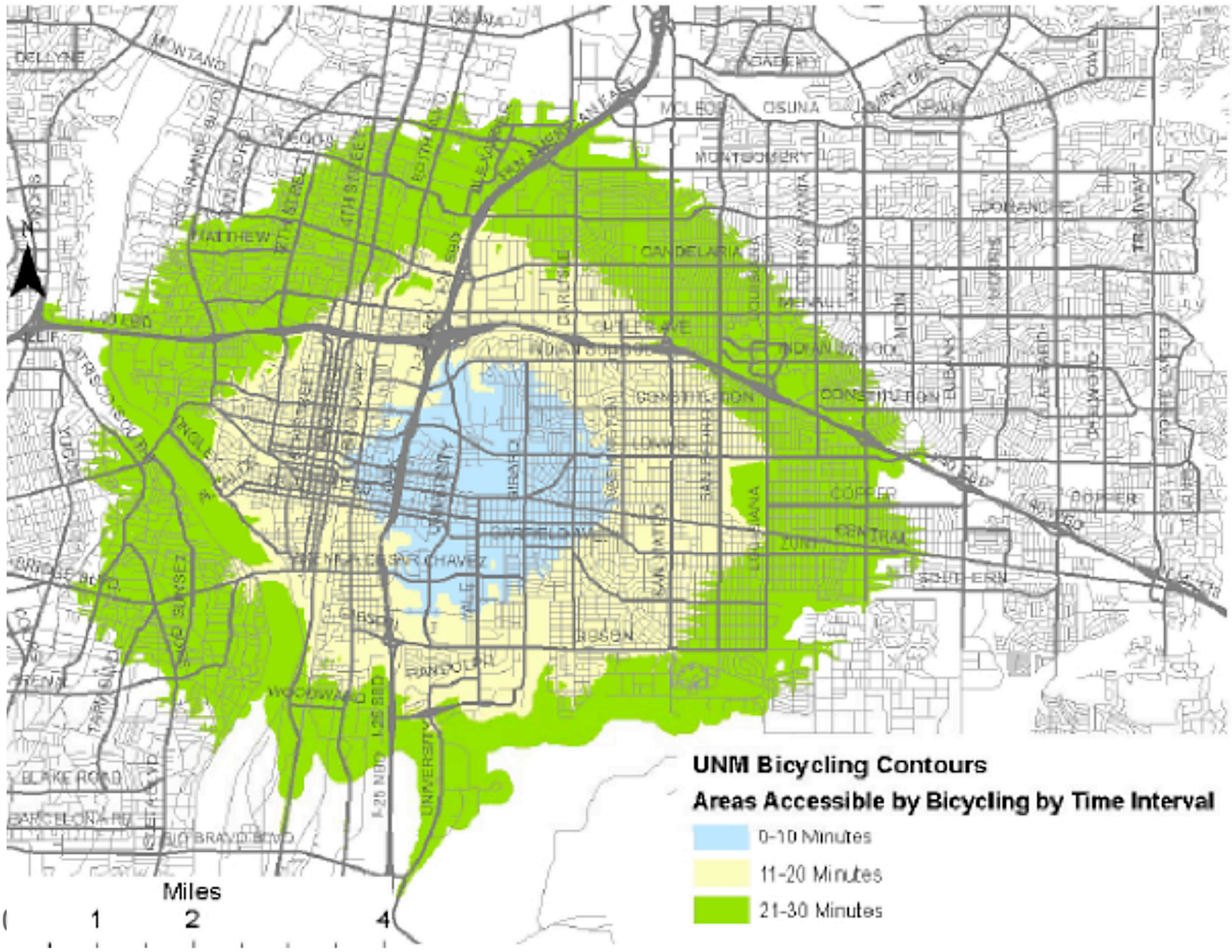
Proposed UNM Area Bike Plan Map



Source: Reference 49

Figure 5-13

UNM Bicycling Contours Map



Source: Reference 3

Walking

Pedestrian access is provided to UNM's campuses through a mixture of pedestrian pathways, sidewalks, and open space. Vehicular access is primarily through a series of arterial and collector roads that have sidewalks. Most pedestrian pathways through the Main Campus are shared with bicycles and have the potential for conflicts.

More than half of the UNM survey respondents to the MRCOG Travel Demand study who lived within one mile of UNM reported walking to their destinations. This is an extremely high proportion which, as would be expected, decreases with distance from campus.

Marketing UNM Transportation

The Transportation Information Center in the Student Union Building resulted from collaboration between PATS and undergraduate and graduate student government bodies and is funded by the Student Fee Review Board, Student Affairs, PATS, and the New Mexico Student Union Administration. PATS is increasingly using social media to communicate with students, faculty, and staff.

Lobo Mobile's application has been available since September 2010, which allows users to access UNM information on any smart phone or iPad/iTouch. Uses include campus maps and directories. Soon, shuttle and ABQ Ride operation times and routes also will be available.

Additional Transportation Studies and Collaborative Efforts

In addition to several independent studies relating to UNM transportation issues, the University has been actively working with city, county, and regional governments to coordinate and collaborate in developing options for addressing the University's and community's local and regional transportation needs. This section describes several such efforts.

Strategic Parking and Transportation Opportunities for UNM

A presentation to a 2010 Student Housing Open Forum [50] by Joshua Rogers, a graduate student employed by UNM's PATS, summarized some strategic opportunities for parking and transportation with a specific focus on the Main Campus. Rogers first described planned physical changes, including an additional 2,000 on-campus dormitory residents and the potential loss of 725 parking spaces over the next several years, as well as possible changes to Redondo Drive, the primary circulatory roadway around the Main Campus. His main question was, how does the University increase access while minimizing impacts on the surrounding areas?

Based on a survey of peer campus institutions, Rogers proposed the following solutions:

- Change parking permit pricing strategies.
- Encourage use of remote parking lots for dormitory residents.
- Use a marketing plan to encourage alternative transportation use.
- Implement a pilot program using a bike kiosk rental program.
- Create Residential Parking Benefit Districts.

A survey of the seven peer institutions selected by Rogers compared the ratio of parking permit price for campus residents to tuition and fees costs and determined

that UNM is low compared to other institutions. He recommended a significant increase in those fees to bring them in line with other parking spots on the central campus while providing an option of much lower fees for remote parking.

The most interesting section of the presentation was the discussion of Residential Parking Benefit Districts. In this concept, already employed at the University of Arizona in Tucson, the City establishes parking permits or parking meters in neighborhoods surrounding the University and returns profits from the program to the neighborhood for local improvements. Residents in the neighborhood continue to receive free on-street parking.

Campus Parking: A Study of a Remote Parking Shuttle

Responding to student complaints regarding slow, unpredictable, and overcrowded shuttle service from the South parking lot to Main Campus, a Civil Engineering graduate student in 2005 undertook a project to investigate the service and to identify economic strategies to improve it [51]. His analyses involved a detailed examination of vehicle characteristics (bus capacities of 48 seated, 22 standing; turning radii of approximately 12 meters; boarding/alighting issues associated with narrow doors and three steps) and service concerns (a need for students to arrive at the remote parking lot 30 to 45 minutes before their scheduled class time, according to driver comments; full buses leaving students behind during peak periods).

Using operations research and industrial engineering techniques, the report concluded that moving the bus stops to avoid entering the South parking lot would reduce the average travel time by about 3.5 minutes and increase the travel time reliability and increase bus capacity. The trade-off would involve longer student walk times to get to the bus, although overall travel time would be reduced and the increased reliability would mean fewer overcrowded buses. Other options mentioned but not examined in detail in the report include replacing aging buses with "transit" type buses with wide doors and low floors to reduce dwell time. Fee increases would, no doubt, be required for this option to cover the significant capital costs. The report also mentions operational and geometric improvements to the traffic signal and street networks to improve travel times. Some suggestions were subsequently implemented independently.

Lobo Development Corporation Strategic Parking Proposal

The Lobo Development Corporation, a non-profit corporation owned by the UNM Board of Regents, has as its purpose the advancement of non-traditional real estate development for the benefit of the University. To that end, it has advanced a 2010 strategic parking proposal, which aims to improve parking and transportation systems at the University [6].

Using a survey of seven peer institutions regarding such issues as the relationships between permit price and supply and demand for parking, the proposal identifies a range of opportunities from minimal cost/minimal policy options to major cost/major

policy changes. All involve increasing permit rates and reducing subsidies for student rates as well as removing current residential student spaces and replacing them with generic spaces. The proposal also suggests a range of marketing opportunities and disincentives, such as the creation of neighborhood business districts in areas where student parking is a problem.

The study specifically categorizes its recommendations into five categories:

- Minimal cost opportunities with minimal policy changes.
  - Create a new image for UNM PATS.
  - Change the PATS website to further encourage alternative transportation.
  - Provide more options for parking permits such as offering two- and three-day parking permits.
  - Register students, faculty, and staff for alternative transportation with incentives.
  - Partner with local businesses for parking.

- Minimal cost opportunities with major policy changes.
  - Remove current residential parking permits.
  - Disallow underclassmen from parking on campus.

- Major cost opportunities with minimal policy change.
  - Develop a comprehensive marketing plan for alternative transportation.
  - Target specific marketing to students, faculty, and staff.
  - Develop a self-service bike rental program (bike-share).

- Major cost opportunities with major policy changes.
  - Increase parking permit rates to reduce demand.
  - Remove or lower discount for student permits.
  - Develop financial incentives to discourage parking on campus.

- Regional parking and transportation.
  - Create neighborhood business districts.
  - Develop a "Take Back the Road" bicycle promotion.

These opportunities could decrease the usage of SOVs and reduce parking needs. However, the number of parking permits sold would decrease, which is a major source of PATS funding. In addition, PATS receives some of its funding through parking fines, which could be viewed as a conflict of interest [6].

UNM/CNM Travel Demand Management Study

UNM, along with CNM, participated in a previously-mentioned Travel Demand study in conjunction with the City of Albuquerque, Bernalillo County, and MRCOG. The study's goal was to develop a framework for a TDM program for the UNM/CNM area, which has a total daytime population of approximately 74,000 and an estimated VMT of approximately 1.3 million, more than 5 percent of the VMT in the region [3, 41, 42].

The MRCOG study is an important source for UNM and CNM data, including information from surveys of UNM staff, faculty, and staff; public meetings on the UNM campus and in the surrounding areas; and interviews with key representatives of the City, UNM, and Bernalillo County, and these efforts are considered a primary data source for land use, travel demand, mode choice, and transit decisions.

The study's recommendations include the establishment of an interagency TDM Committee to include all parties, including representatives from both UNM and CNM. Recognizing that good transit service results in high utilization rates and that parking is probably the most challenging issue facing the area, the study further recommends that UNM, CNM, and the City of Albuquerque work together to develop a long-range parking and transportation plan. Additional recommendations include efforts to locate more housing for faculty, staff, and especially students, on or near campus or close to areas offering premium transit service. Promotion of bike and pedestrian use, especially for areas close to campus, was also recommended.

One potentially controversial recommendation suggests reducing peak student loadings throughout the day, either through adjustment of class schedules (including offering Saturday classes), offering more on-line or other remote classes, or congestion pricing–charging more for parking during periods of heavy loads.

UNM/CNM Area Transit and Land Use Coordinating Project

MRCOG received $500K in funding from the Federal Highway Administration (FHWA) Transportation, Community and System Preservation (TCSP) grant program for a UNM/CNM Area Transit and Land Use Coordinating project. The project will identify, evaluate, and pursue the implementation of TDM-focused activities to promote the use of alternative modes of transportation to and within UNM and CNM. The project also will integrate the area's unique mix of land uses and the mix of business and historic Route 66 (which bisects the institutions) to encourage supportive public- and private-sector development and ensure access to existing jobs, services, and residences [52].

UNM Multi-modal Transportation Center

UNM submitted a $40M funding request for a UNM Multi-modal Transportation Center. The center would be a hub for transportation alternatives to enhance the coordination of the interactions among pedestrians, bicyclists, inter-regional shuttle bus service, light rail, rapid transit, intra-campus express bus service, and vehicle traffic by building a 1,400-space structure. The Center would be planned and managed by UNM PATS in cooperation with the Rio Metro regional transportation authority, MRCOG, NMDOT, and the Albuquerque Transit Department.

Rio Rancho Campus Infrastructure Proposal

The UNM Campus Planning and Development Department, MRCOG, and NMDOT have prepared a funding request to FHWA for infrastructure to create better access to the new UNM campus in Rio Rancho, which is 18 miles (29.0 km) west of the Main Campus.

SECTION 6

ITS Applications to Campus Environments

ITS has been described as part of a transportation toolkit to better manage the transportation system. It uses advanced and emerging technologies and information to improve mobility and productivity and enhance transportation system safety. ITS tools have received increased attention as engineers and planners have come to realize that it was becoming increasingly difficult to continue to build major new streets and highways and rely only on expanding existing facilities. Common ITS technologies that have been deployed include ramp metering, traffic signal coordination systems, red-light cameras, and various types of traveler information systems [53].

ITS for Transit

According to the Volpe National Transportation Systems Center, five broad technology/categories of ITS are relevant to transit applications [54]:

- Fleet Management Systems
- Traveler Information Systems
- Electronic Payment Systems
- Transportation Demand Management
- Transit Intelligent Vehicle Initiative

The USDOT's Mobility for All Americans initiative has identified the following benefits of transit ITS [55]:

- An improvement in the availability of information about public transportation services.
- Improved access, egress, and ease of transit use.
- Improved paratransit services, including taxis, demand response services, and other forms of flexible route services.
- An improved multimodal approach to coordinated transportation services.

Fleet Management Systems

Technologies in this category include AVL systems, communication systems, APCs, and traffic signal priority (TSP) systems. According to a 2005 report [56], AVL, communication systems, and computer-aided dispatch allow the transit provider to manage service in real time to avoid gaps in service and enhance

reliability. AVL, APCs, and service planning decision support systems can provide improved data for service planning. These systems provide real-time information on bus location, the actual time that a bus passes a time point, and passenger loading information. This information would allow a transit operator to make informed decisions on schedule adjustments and redeployment of services to reduce vehicle overcrowding. Another component—maintenance monitoring and information systems—provides information that permits the improved scheduling of vehicle maintenance, possibly reducing vehicle breakdowns.

Another popular tool is TSP, which can range from signal optimization, where signals are timed to favor all vehicles on the corridor, to green time extension for transit vehicles approaching the intersection. Alternatively, the red-signal interval may be truncated if a transit vehicle is waiting on the street approach. It is reported that TSP can reduce both the mean and standard deviation of the travel time.

The specific technologies that permit the implementation of fleet management systems continue to improve in reliability, while many costs are decreasing.

Traveler Information Systems

The principal systems in this category include pre-trip and multi-modal traveler information systems, in-terminal and wayside transit information systems, and in-vehicle transit information systems. The information may be provided periodically (routes and schedules), daily/hourly (significant service disruptions), and up-to-the-minute (arrival time for the next transit vehicle). The Internet is used by many transit agencies to share information on routes and schedule changes; the method is relatively inexpensive and accessible to many, but not all, potential riders; automated phone systems provide an alternative that is accessible to others. The posting of vehicle arrival times at transit stops, which has been common on heavy-rail systems, has become increasingly common on bus transit systems. This feature is very popular with riders, primarily because it removes doubt about upcoming arrivals. In-vehicle transit information, which is common on rail transit systems, is also being used on buses to identify the next transit stop; this tool is especially helpful for riders with visual impairments. Smart phone applications and social sites are also becoming increasingly popular as traveler information systems; this is particularly attractive to younger riders.

Electronic Payment Systems and Smart Cards

The intent of electronic payment and smart cards is to simplify payment and improve accountability. Rail transit systems, including San Francisco's BART and Washington, DC's Metro have used electronic payment cards since their beginnings. The card is read as the rider enters the station at the trip origin and again when the rider departs the destination station; this allows fares to be based on trip length and time

of day. The reasons for considering electronic fare collection for buses are somewhat different. The most obvious reason is that it eliminates cash handling. It could also enable alternative fare policies, similar to rail transit, if that was desired. Some systems have employed this method to facilitate transfers. There is also the potential to reduce the dwell times at bus stops, although real-world studies have found that there are minimal time differences per passenger among swipe cards, smart cards, and exact change fare payment.

Transportation Demand Management

Dynamic ridesharing can reduce the number of single occupant vehicles on the road by providing an opportunity for a person who is unable to drive on a particular day to join with one or more persons making the trip. This differs from typical carpools in that the arrangement is made in real time for a single trip. The individual submits a request to an operations center by telephone, email, or input to the internet. Dynamic ridesharing benefits the individuals whose usual mode of transportation is unavailable on a given day. The technique is particularly useful in areas that are poorly served by public transit.

Transportation management centers (TMCs), which are becoming increasing common throughout the country, help transit agencies improve transit service by providing current information on traffic conditions and incidents. Input to TMCs typically comes from closed circuit television (CCTV) cameras and loop detectors. Transit vehicles equipped with AVL technology can act as traffic probes; they can provide valuable information on traffic flow, especially on those streets that are not currently monitored by the TMC. Changeable message signs controlled from a TMC provide useful information for transportation system users.

Transit Intelligent Vehicle Initiative (Connected Vehicle Program)

Over the past decade, various agencies have attempted to develop new technologies for transit vehicles in an effort to enhance their safety [57]. Perhaps the most promising is a frontal collision warning system. Statistics show that 25 percent of all transit vehicle collisions involve frontal impacts. The system uses sensors that detect the presence of objects and algorithms that identify and interpret potentially hazardous objects; a driver-vehicle interface alerts the operator. A second initiative is developing a side collision warning system, which uses ultrasonic sensors on both sides of a bus that detect objects and pedestrians during close maneuvers. The systems show promise in detecting objects in blind spots. Study has also been directed toward the proper driver vehicle interface

that would take the detection from the front and side collision detection systems and share that information with the operator.

Another system provides collision warning for rear impacts. Nearly two-thirds of rear impacts with transit vehicles occur when the vehicle is stopped in a traffic lane. However, the intent of this system is not to alert the operator but rather to warn motorists in following vehicles that they are in danger of impacting a bus. Minnesota is operating a bus rapid transit (BRT) system on more than 200 miles (321.9 km) of freeway shoulders. The problem is that the shoulders are typically 10 feet wide, while the BRT vehicles are 9 feet wide from one rear view mirror to the other. The operator must maintain lateral control within just 6 inches to avoid collisions. Although this is feasible under normal driving conditions, it becomes more difficult during adverse conditions found sometimes in the Minneapolis area, including bad weather, low visibility, and high traffic congestion. Options for vehicle-lane assist technology have been investigated as part of the intelligent vehicle initiative.

Other, more recent initiatives with transit safety applications have been described in USDOT's ITS Strategic Research Plan [58] and in a Fact Sheet distributed by the ITS Joint Program Office ([59]. These priorities, party of the Transit Connected Vehicle Program, include the development and testing of systems for pedestrian warning applications for transit vehicles as well as warning systems for vehicles turning right in front of a transit vehicle.

Other applications of what is referred to as the Transit Connected Vehicle for Mobility Program include communication applications between providers and travelers (T-CONNECT), using GPS and mobile devices to provide demand-responsive services (T-DISP), and using both in-vehicle and mobile devices to provide dynamic ridesharing (D-RIDE) [59].

Recent publications from TCRP have addressed the ITS transit issue, including five documents listed in the References [60–64].

Options for the Albuquerque Area

Albuquerque has already implemented some of the ITS for transit discussed above. It appears that the top choices for introduction or expansion in the Albuquerque area include the following:

- *AVL:* The City of Albuquerque's three Rapid Ride lines (Red, Green, Blue) use AVL technology. The bus stops, at 0.5–1.0-mile intervals along the routes, are fixed structures with displays showing when the next bus will arrive.
- *Arrival time information:* The Rapid Ride routes already provide arrival time information for buses. This could be expanded, perhaps starting with segments in downtown Albuquerque where multiple routes share the same stops. This will require additional AVL equipment in the buses on these

routes and the construction of more permanent transit stops on these routes to house the arrival time displays. It is probably not feasible from an economic standpoint to expand this tool to the entire network. Future plans are to integrate with ridership data, improve real time data, and make the information available to the public.

- *Transportation Management Center*: Albuquerque has a transportation management center, albeit primitive compared to the centers in other U.S. cities. It employs loop detectors and CCTV, but deals primarily with the local system of interstate freeways. Equipping more transit vehicles with AVL technology and using those buses as traffic probes could expand system coverage to streets on the arterial network. In comparison with the cost of installing other detection devices, including traffic loops and CCTV, this could be a less costly alternative.
- *TSP:* In Albuquerque, travel time by public transit is greater than that for the personal automobile. To attract riders from their vehicles, transit must pursue methods to reduce travel time. There is evidence that improved TSP for transit can reduce both mean and standard deviation times for bus riders. Opportunities for improving TSP warrant further consideration.

The options cited above all deserve more study; it is important to note that they are not listed in the order of their expected benefit cost ratio.

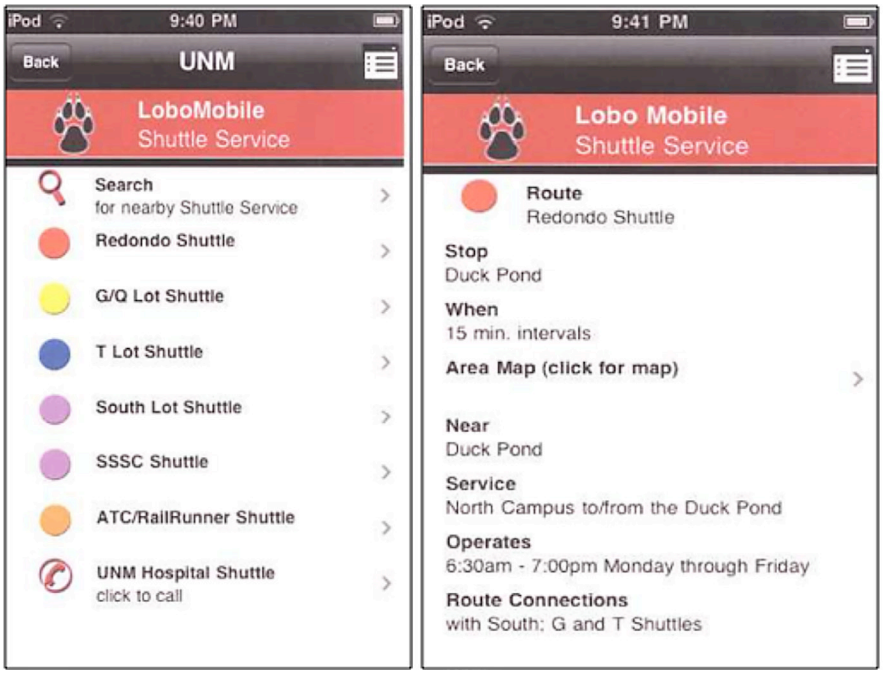
ITS Applications for UNM Transit and Parking

UNM's PATS provides online maps of its shuttle routes as well as a link to the transit routes operated by the City of Albuquerque, but it seems that the feasible ITS options for the UNM shuttle systems are more limited than for Albuquerque's ABQ Ride system. One promising choice would be AVL, which could be coupled with an in-terminal information system. This would work well at shuttle stops that currently have structures. Unlike Albuquerque's system, which publishes timetables for its routes that are accessible on the Internet, there is no published timetable for the UNM shuttles (except for the shuttle to the ATC). The UNM website gives the hours of operation by day of the week. Students are very used to having schedules for class times and other events at the University, but when they get to the shuttle stop, they simply have to wait for the shuttle, not knowing when it will arrive. AVL and a "next shuttle" display would be a helpful service for the shuttle riders.

UNM Information Technologies, in fact, has already developed a "Where's My Bus?" application for mobile devices and computers that displays the real-time location of ABQ Ride buses that serve the University's Main Campus. The app, which currently tracks 10 bus routes, uses transportation data provided by the City of Albuquerque's Open Data Initiative. The information includes current

location, direction, and time; bus speed; and next stop location and estimated time. UNM is piloting a program with 10 of its buses to allow tracking with the app. Phone screenshots are shown in Figure 6-1.

Figure 6-1
UNM "Where's My Bus?" Application



Source: http://lobomobile.unm.edu/

Duke University has a similar system (TransLoc.com) that displays real-time locations for the 28 buses in the University's fleet. The system also tracks the buses of other transit systems in the area and wait times at each of the 113 bus stops on campus. Delays or changes to bus routes are also available [65]. Other universities with similar AVL systems include Oklahoma State University in Stillwater, which funds the service with student fees to the amount of $35,000–$40,000 per year [66] and New Mexico State University in Las Cruces, which recently equipped several campus bus shelters with LED displays and free Wi-Fi access. GPS-equipped buses may be tracked by text, Web, or phone to get arrival information [67].

The free shuttle system at Yale University in New Haven, Connecticut, which serves more than one million passengers per year, including about 13,000 demand response trips per month, is able to deviate from its fixed-route service to accommodate demand response requests thanks to software that re-calculates schedules and routes in real time. Drivers are able to service flag stops and demand response calls while still being able to provide accurate arrival time estimates to waiting passengers [68].

Even bicycle travel can benefit from ITS technology. The University of Minnesota, for example, has implemented a bike reward system by distributing Radio

Frequency Identification (RFID) chips to bike commuters and constructing a series of cell towers on frequent bike commuter routes. Equipped bikes passing the towers are detected, and accumulated points are used to get discounts on bike equipment and services. Construction costs are estimated to be about $5,000 per tower [69].

Using a mobile app developed by Parkmobile USA, Inc., drivers choosing to park in a UNM structure, such as the Cornell Parking Structure or the Yale Parking Garage, may now purchase more parking time without having to return to the parking location. For a nominal $0.35 per transaction, parkers can add time simply by communicating their zone location, stall number, and the amount of additional time they wish to purchase. The service will also send a text message notifying the parker when their time is about to expire.

SECTION 7

Findings, Recommendations, and Conclusions

The purpose of this study was to identify successful TDM strategies and programs at multi-nodal urban universities that could be implemented at UNM to improve transit operations and increase alternative mode utilization. The project also examined mobility enhancements (primarily transit) and alternatives for multi-modal utilization and multi-nodal coordination of both internal transit service at UNM and CNM and those provided by Albuquerque's ABQ Ride system.

The project plan for addressing these issues consisted of a literature search on sustainability issues related to transportation on campuses nationwide; an on-line survey and evaluation of existing multi-nodal campus planning models; and data collection and analysis of the existing campus travel issues at UNM as identified both from existing documents and additional acquired data. This information was used to develop both short-term operational improvement options for the UNM campus as well as concept-level recommendations to address longer term issues.

Transportation issues associated with a mid-size university located near the center of an urban area are both numerous and complex; this is particularly true when a significant portion of the student population resides off campus and, in addition, holds down an off-campus part-time job. Such is the case at UNM.

Findings

A wide range of transportation options was identified. However, it is difficult to assess strategies and their impact on programs and operations because much depends on the institutional commitment to sustainability efforts, the campus setting, the campus location, student density, and the level of institutional financial support for transportation programs.

Connectivity among campuses is a common issue among multi-nodal campuses. Significant challenges emerge for campus transportation planners to not only provide their own services across extended areas but also to coordinate their services with other metropolitan or regional transportation operators. The literature review yielded little information on the interaction of various modes such as walking, bicycling, using transit, and using auto, particularly for those campuses characterized as having more than one geographic location.

TDM strategies that seem to influence transportation behavior of students, employees, and visitors to campus locations include controlling the supply and price of parking, financial (dis)incentives to drive alone or travel in other modes, the level of transit service available, and the ease of bicycle use. These approaches may have positive impacts on traveler mode choice, time of day traveled, frequency, and route of travel. This, coupled with a university's unique attributes, especially in terms of trip density to a limited number of destinations, should lead to the successful application of various TDM measures.

If campuses are considered as communities, then the application of the measures described above can be seen to mirror FTA's Livability Communities Agenda, which is intended to help communities grow in ways that ensures a high quality of life and sustainable economic growth with transit and other alternative modes as essential components.

Multi-nodal Campus Case Studies

The seven multi-nodal campus case studies revealed transportation initiatives common to all campuses. The most common characteristics among the universities were inter-campus transit services to connect individual campuses, free or reduced transit passes, increased service frequency, and extended service hours for their systems.

The success of university transit operations is also dependent upon the vitality of its alternative transportation programs. Often, multi-nodal universities have hospitals, medical schools, and/or research centers that are separate from the main academic campus and these centers have different transportation needs than traditional main campus activities. Headways and types of transit services depend mostly on the distance between campuses and student density. Key findings identified in the case studies include the following:

- Sustainability goals are often used as the overarching concept for transportation services, including parking and alternative transportation modes: bicycling, walking, carpools/vanpools, and car-sharing. However, only a few universities prominently display transportation-related policies, reports, and data on their websites.
- Successful transit programs include free transit passes to students and employees, allowing free/subsidized access to bus and rail transit; high-frequency and late-night transit; transit amenities at bus stops; and guaranteed emergency rides home for those who participate in transit pass or carpool programs.
- Social media and mobile device applications are important marketing and communication tools for university transportation programs.
- Compressed work weeks and telecommuting are encouraged.

- Carpools and vanpools providing access to shared vehicles for some trips through nonprofit or commercial carshare programs or on-campus car rentals (all universities)
- Alternative transportation modes are marketed in new student orientation programs.
- Infrastructure has been improved and programs added to encourage walking and bicycling.
- Increased parking rates have reduced demand (ASU, UC Davis).
- Coordination with public agencies and neighborhoods develops integrated transportation systems (Duke, UC Davis).

The case studies also identified several innovations in university transportation programs:

- Maintaining a motorist-free campus cores (UT Austin, Duke, UC Davis).
- Prohibiting first- or second-year students from bringing cars to campus (Duke).
- Using Web-based user-friendly dashboards that provide metrics for sustainability programs on transportation, graphic representation of multi-year modal share data, and other related performance measures (UW).
- Using transportation- and sustainability-focused branding to market and promote alternative transportation programs (UT Austin, UW, UC Davis).
- Integrating sustainable transportation goals into the design of transportation portals (UW, UT Austin, ASU).

UNM Case Study Findings

In spite of an increasing student population, UNM has been successful in using TDM strategies resulting in a reduction of single occupancy vehicles (SOV) usage from 78 percent in 2004 to 49 percent in 2010. This significant decrease is attributed to the implementation of the free ABQ Ride transit program in 2007. UNM is continuing its transition from a commuter university to a sustainable, urban, residential university by increasing on- and near-campus housing by decreasing available parking and implementing TDM strategies. Key findings from the UNM case study include the following:

- In 2011, UNM Regents adopted a Consolidated Master Plan for the three campuses that focuses on multi-nodal and multi-modal transportation connectivity issues, addressing parking in a comprehensive manner, improving pedestrian crossings at major intersections, increasing transit, pedestrian, and carpool/vanpool utilization, and restricting auto access to the Main Campus.
- UNM's financing model for its transportation services needs to be reassessed. Current UNM transportation services are funded solely through

parking permits and parking enforcement fines. The ongoing decrease in surface parking will constrain permit revenue. Limited funding restricts UNM's ability to purchase new vehicles for its shuttle services and enhance alternative transportation programs.

- The free Lobo Shuttle transports students around the Main Campus and to/from remote parking areas located both north and south of the Main Campus. This shuttle service had more than 1.8 million riders in 2010. The UNMH or North Campus shuttle serves only the medical complex. However, the Main Campus's PATS department performs parking regulation enforcement responsibilities and issues parking permits for the North Campus. The North and Main Campus shuttle systems have separate administration, planning, and operating environments.
- In 2010, ABQ Ride, the City transit provider, served 11.7 million riders, a 39 percent increase from 2009. Approximately 14,000 free transit passes were issued from UNM resulting in about 15 percent or 1.8 million ABQ Ride passengers.
- Modal split comparisons show that 51 percent of UNM students use alternative modes compared to 46–87 percent at case study universities. In regards to UNM employees, 41 percent use alternative transportation modes compared to 22–59 percent at peer institutions. On the other hand, UNM, at 11 percent, had the lowest percentage of on-campus housing; other multi-nodal universities ranged from 15–39 percent.
- MRCOG is the lead agency in several initiatives concerning transportation issues internal to UNM and the surrounding areas. These include a TDM study exploring transportation needs and opportunities for UNM and CNM; applying for a multi-modal transit center located on the North Campus; and conducting an FTA-funded study for an alternatives analysis study for the heavily travelled north-south corridor from the UNM/CNM area to the Albuquerque airport. These initiatives include participants from local, city, and state agencies.
- UNM lacks an internal transportation coordination committee as well as formal participation in regional MRCOG transportation committees.

Recommendations

While some of these recommendations have been documented in previous UNM studies and reports, the lack of implementation necessitates that they be restated and reemphasized because of their importance. The recommendations are grouped both according to time frame (short-term vs. long term) and whether each is policy or operations related.

Short-Term Policy Recommendations

- Continue UNM's participation in the ABQ Ride free transit pass program.
- Greater UNM involvement is needed both internally through the creation of a Transportation Coordination Committee and externally with the broader transportation community. The creation of an internal Transportation Coordination Committee, for example, with members representing APTS, Campus Planning and Development, and academic units with interest/expertise in transportation issues (such as the departments of Civil Engineering, Community and Regional Planning, and Public Administration). The University, in fact, has a template for such a committee—the Transportation and Parking Advisory Committee, which functioned for a number of years in the late 1990s with representation from faculty, staff, and students. It consisted of four sub-committees—Transportation Planning, Parking Regulations and Enforcement, Transportation and Parking Capital Investment Planning, and Parking Citation Management and Appeals.
- Create an internal UNM Transportation Coordination Committee to facilitate participation in the broader involvement in the external transportation community such as MRCOG's including the Transportation Coordinating Committee and the Transportation Program Task Group. Having an internal UNM committee would also facilitate involvement in other regional planning efforts of MRCOG, ABQ Ride, the Rio Metro Regional Transit District, and NMDOT.
- Create a new staff position within UNM's PATS to perform planning or operational responsibilities including enhancing alternative transportation initiatives.
- Participate in APTA's Small Operations Committee, including the biennial Transportation and University Communities Conference, which is the only national conference addressing the unique transportation needs experienced within university communities. Attendance and participation at these conferences, as well as involvement in other committee activities, will allow interaction with other professionals experiencing the same challenges and opportunities of operating transportation services in a university environment.
- Develop branding for UNM transportation programs, including linking the University's sustainability goals to UNM's transportation portals that reflect those priorities.
- Create linkages between the UNM PATS website and University transportation-related reports and resources. Develop user-friendly dashboards for displaying results from the annual commuter survey and other performance measures.

- Use targeted marketing and outreach activities to grow transit ridership to/on campus. Partner/collaborate with student government leaders and student newspapers. Integrate social media for transmitting and monitoring comments about UNM transportation services.
- Continue to develop mobile device applications to enhance transportation services. Current applications include the Parkmobile and "Where's My Bus?"
- Revise the UNM Commuter Survey to include attitudinal questions relating to the campus shuttle service, the ABQ Ride Free Bus Pass program, and campus transportation issues in general. Administer to all faculty, staff, and students. In addition to modal choice data, use the survey to assess the number students who work off campus.
- On the South Campus, create better coordination of special event parking and remote parking among the UNM Athletics Department, the Science and Technology Park, the City of Albuquerque, and CNM.

Short-Term Operational Recommendations

- Drive times for the South Lot shuttle could be reduced by modifying the route to avoid buses entering the parking lots. New transit buses with low floors and wide doors would allow quicker loading and unloading and further reduce dwell times.
- Use automated gates at the Terrace Avenue exit to limit Main Campus access to only UNM shuttles.
- Relocate bus stops to remove underused stops such as the ABQ Ride Route 50. This action would conform to the University's long-range goal of making portions of Redondo Drive "limited to pedestrians, bicyclists, shuttles, and maintenance vehicles." The removal of City buses from Redondo will also eliminate congestion due to buses waiting for a traffic signal to change at MLK Blvd. between Redondo and University.
- Because of limited ridership, examine benefit/cost of UNM's Main Campus and UNMH's fixed-route shuttle between those locations and the Alvarado Transportation Center's morning and afternoon Rail Runner regional rail connections.
- The shuttle service from the "T" parking lot averages only a little over 500 riders per day and is only about 1,500 feet walking distance from its most remote destination. The permit price could be raised to more fully cover costs or the service could be curtailed due to its relative walking proximity to many campus locations.

Long-Term Policy Recommendations

- Additional recommendations from the Lobo Development report [6] include efforts to locate more housing for faculty, staff, and especially students on or near campus or close to areas offering premium transit service. For areas in close proximity to campus, bike and pedestrian use should be promoted and encouraged. The report also suggests substantial increases in parking permit rates to reduce demand as well as the removal of the discount currently given to students parking, and residing, on the main campus. One potentially controversial recommendation suggests reducing peak student loadings throughout the day, either through adjustment of class schedules (including Saturday classes), offering more on-line, or other remote classes, or through congestion pricing—charging more for parking during periods of heavy loads.
- Two TDM measures have been suggested in a report prepared by a consultant to California State University–Chico [70]. Both recommendations relate to parking for students living in on-campus residence halls and may have application to UNM as it attempts to increase its on-campus student presence. The first provides preferential housing for students choosing to live car-free in new residential halls being constructed. Rather than rely on a lottery system, students who choose to not bring a car to campus receive first priority in selecting a room in the new facility. Additional incentives include provisions for convenient, covered (perhaps even indoor) bicycle parking available only to residents. A second option involves remote, long-term parking for on-campus residents. If a car-free campus is the goal, all residence hall parking could be moved from current locations to remote lots served by university shuttles or other transit service. Special discounted permits could be provided to campus residents who choose to park in remote lots and secure bicycle parking could be provided. One potential drawback is security concerns for students returning to the remote lots late in the evening or on weekends.
- University settings, with their relatively small areas, short trip lengths, and a student population used to traveling by bicycle, are ideal locations for bike-share programs. UNM has, in fact, explored bike-sharing for on-campus as well as for short off-campus trips (to Nob Hill, for example). Preliminary program costs, as reported to the Associated Students of UNM (ASUNM, the student body governing group) were $353,000 for a startup system of 9 stations and 46 bikes. Annual operating costs of $60,000 were also estimated. A recent summary in Westernite, the official publication of the Institute of Transportation Engineers Western District, describes the state-of-the-art of university bike-sharing programs [71]. The following data from that report could be used to not only provide contact information to fine-tune UNM cost estimates but also to provide benchmarks for program effectiveness:

  - "Flashpoint," Kent State University, OH, 62 bikes, 7 stations, 57 trips/day
  - "Bike@ OU," Oakland University, MI, 200 bikes, 12 stations
  - "Zotwheels," UC Irvine, 28 bikes, 4 stations, 7 trips/day
  - "Green Bike," Washington State University, Spokane, 80 bikes, 9 stations, 32 trips/day
  - "CycleUshare," University of Tennessee, Knoxville, 10 bikes, 1 station

- More recent information on bike-sharing from the University of Tennessee describes a pilot test of a fully-automated electric bicycle (e-bike) sharing program. Two stations, one on the university's Main Campus and the other on its Agricultural Campus, will each be fitted with 10 bicycles, 7 of which are e-bikes. The e-bikes (bicycles with a motor which activates when pedaling becomes difficult) will be attached to a battery charger when on the bike rack. The system is fully automated with only a swipe from a university ID to check out and return the bikes. The cooperative project, with both private and public funding, will test both the operational efficiency and the economic feasibility of the system along with user response.
- The university should evaluate the success of its Zipcar program on campus and compare it with recent personal car-sharing networks, where individuals enroll their own vehicle to be rented by others on a short-term basis (think Zipcar without the financing and fleet maintenance). Several of these options have sprung up on a number of West Coast campuses recently including Stanford, UC Berkeley, USC, and UCLA. The common business model has vehicle owners setting their own rental rates with companies taking a percentage, primarily for insurance. The companies also vet driving records and prescribe vehicle acceptance standards. Renters either fill the tank or are tracked electronically and charged mileage. Even face-to-face key swaps are not always necessary.
- Drive times for the south lot shuttle could be reduced by modifying the route to avoid entering the parking lots. The analysis by Lapson [51] suggests that although students would walk farther to get to the bus stop, their overall travel time would be reduced. A new curbside bus stop on Avenida Cesar Chavez would have to be constructed. Lapson also suggests that new transit buses with low floors and wide doors would allow quicker loading and unloading and further reduce dwell times.
- In line with outsourcing efforts in other areas of university life (food services, custodial services), some universities are considering selling or leasing their parking operations to a private operator. Ohio State University, for example, is reported to be considering a 50-year lease of its parking facilities for $375 million.
- UNM should also consider using student drivers. According to TCRP Synthesis 78 [14], this is common practice in the industry, with over one-

half of the 28 agencies providing university transit services responding to a survey that they employed student drivers and, in many cases, actively recruited students. Student drivers, usually with more flexible schedules, may also be available at lower cost, not only because of lower wages, but also because their part-time status would result in lower benefits. Survey respondents indicated that little additional training was seen as necessary for prospective student drivers, although some minimum age restrictions and possession of a Commercial Driver's License (CDL) were typically required. Perhaps the industry's best example is Unitrans, the UC-Davis system. In operation since 1968, all of the system's drivers and supervisors, as well as most of its support staff, are students at the University working part-time. A similar model at could employ not only UNM students but students from Applied Technology programs such as Transportation Technology at CNM.

- The University should support regional efforts to create a Multimodal Center to serve as the connection point for the City, Rapid Ride Network, and the UNM Shuttle System, to be located on the UNM Campus at Lomas Boulevard and I-25. The center would provide parking and be a major distribution point for visitors, faculty, students, staff, and patients to access the campus bus systems, as well as walking and biking paths.
- There is a need to examine transportation funding models from other universities from both those identified in the Section 4 case studies as well as those from other institutions including North Dakota State (NDSU) to determine a path forward in addressing current revenue generation limitations. The current funding model for UNM PATS, which relies on revenue from only permit fees, parking fines, and special event parking, is unsustainable. As more surface parking area is consumed by other higher-priority uses, fee revenue will decrease. Absent any dramatic increase in parking rates, other additional revenues, such as student fees, should be considered.

  - NDSU has developed an award-winning partnership, originating with a Congestion Mitigation and Air Quality (CMAQ) grant in 1991, with MATBUS, the Fargo, ND-Moorhead, MN area transit system.
  - NDSU pays an annual per-student fee for its UPASS program from an internal transportation fund populated from appropriated State funding. The current fee is $6 per FTE student for the academic year. Student IDs are programmed to be read by MATBUS's farebox system.
  - NDSU also pays annual estimated operating costs for specific MATBUS routes, such as campus circulators and routes between the main campus and a new downtown campus.
  - Other successful campus transportation models should be examined including those of the Champaign-Urbana Mass Transit District (University of Illinois), Central Area Transportation Authority (Penn State), and the UMASS Transit Service (University of Massachusetts).

- Implementation of UNM's 2011 Consolidated Master Plan needs to proceed with, in particular, its connectivity goals among campuses through a merged, unified transportation system and a robust alternative transportation system.

Conclusions

Like other multi-nodal universities in the case studies, transportation initiatives at UNM tend to focus on similar topics. Institutionally, recommendations from previous UNM campus master plans, studies and reports have strongly supported connectivity goals including a merged, unified, and consolidated transit system coupled with reduced SOV usage and a motorist-free Main Campus. Other recommendations about external connectivity issues should emanate from FTA-supported initiatives now underway.

Operationally, the most important transportation issue at UNM is developing a stable, long-term funding source for its transportation services. For example, the current model for funding new buses on a 12-year replacement schedule is unstable. Consideration should be given to a student "transportation" fee. To be successful, it would need the support of the student body and its leadership. Efforts to elicit support from students should include use of alternative transportation as a green approach to congestion and air quality issues.

APPENDIX

A

Sustainable Marketing-Oriented TDM Campus Strategies

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Bicycling	General promotion and marketing activities for encouraging commuters to bicycle. Marketing messages can include health and cost savings, convenience, other benefits.	Locations along multimodal corridors for enhanced bicycle share. Promotion aids use of facilities. Some campuses have developed high bicycle mode share.	Bicycle commuting declines during winter in many climates. Unless marketed with bike-and-ride, market for bicycle may be limited.	Medium (modal shift); Low (VMT reduction)	Low
Bicycle rider guide	Develop specific guide for particular worksite that includes bicycle routes, locker/ rack locations, other information pertinent to bicycle commuter. General campus information can be included as "cut-and-paste" to save costs.	Assisting bicyclists with accessing their specific worksites, including where/how to park their bicycle, prepare for workday has been proven to be more effective than promotion alone.	General limitations of bicycling promotion apply. Students will not change their behavior simply by publishing a guide at worksite; requires word-of-mouth promotion, preferably by transportation coordinator.	Low (modal shift); Low (VMT reduction)	Low
Bicycle user group	Organization of bicyclists and bicycle commuters tend to increase sustainability of bicycle commuting over time.	User groups help encourage each other to bicycle more often, especially when combined with social interaction (such as a bike station café).	Those inclined toward users' group are most likely already bicycling on a somewhat regular basis. As such, program only affects how often users bicycle, not typically encouragement of new riders.	Marginal (modal shift); Low (VMT reduction)	Low
Bike station	Bike stations provide secure and covered parking for bicyclists. Most effective in dense concentrations of worksites or classrooms, can serve as an encouragement to commute by bicycle.	Bike stations have been used to encourage development of new safety (from theft) and complementary services (such as showers, lockers, other services offered by bike stations).	Total modal shift is limited. Additional limitations of bicycling promotion and bicycle users' group apply. Competition with local bike shops.	Low (modal shift); Low (VMT reduction)	Low
Bike-to-work day (week)	Provides many commuters with "first-time" experience with bicycling to work. Small proportion every year may become habitual bicycle commuters.	Allowing a day where commuters can be introduced to ease of bicycle commuting is a great way change commuting modes. Found in Denver area that more than 25% of new participants will continue to bicycle to work after event.	Bike-to-work day usually occurs only once a year; building a sponsor and promotions list can be taxing. Participants tend to fall back to using an SOV after a couple of months.	Medium (modal shift); Low (VMT reduction)	Medium. Bike-to-work day is a high-profile event
Carpool promotion	General and marketing activities oriented toward encouraging commuters to carpool. Marketing messages can include cost savings, stress reduction, socialization, convenience, environmental reasons, other benefits.	Promotion /marketing very important in introducing and educating people about carpools. When partnered with ride matching events, can help provide for trips that are poorly served by transit.	Carpool participation declines over time if marketing programs are not continued.	Low (mode shift); (VMT reduction)	Low

Source: Reference 16

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
General marketing	Comprehensive marketing of all modal options, how to best make use of them, are key components of TDM promotion. Marketing materials can include flyers, brochures, posters, and targeted e-mail messages.	Marketing more effective when emphasizes positive benefits commuters will achieve from using alternative modes, including exercise/ financial incentives. Marketing that supports other TDM strategies that improve transportation choice or provide tangible incentives have been proven to show significant long-term impacts on travel behavior.	Travel impacts of TDM programs that rely only on marketing tend to decline over time as participants lose interest. TDM also faces competition from all other marketing messages. Strategies may be more effective with personalized information, face to face contact.	Medium (modal shift); Low (VMT reduction)	Medium, depending on specific campaigns
Transit promotion	General promotion, marketing activities oriented toward encouraging commuters to use bus/rail alternatives. Activities can include bus route maps, brochures, posters, how-to-classes, free-ride days; campus transit fairs, information at student/employee orientation.	With promotion of services to regional travelers, commuters may better connect how to use regional transit to access worksites.	As with general marketing programs, transit promotion faces competition from all other marketing messages. If promotion misses its target market or carries an uninteresting or confusing message, will be ineffective.	High (mode share); Medium (VMT reduction)	Medium
Transit rider guide	Rider guide oriented to new bus riders can help overcome predispositions against riding bus due to lack of information. Items can include how to reach a bus schedule, where to wait for bus, how to use bikes-on-buses racks.	Similar to bicycle user guide, provides potential users with information on how to use bus system Research has shown that "not know what to do" is #2 reason (besides convenience) for why people state they do not ride bus.	Will have limited appeal and effectiveness. Information overload becomes concern. Employees will not change behavior simply by publishing guide at work site; will require word-of-mouth promotion, preferably by employee transportation coordinator.	Low (Low shift);Low (VMT reduction)	Low
Vanpool promotion	General promotion, marketing activities oriented toward encouraging commuters to vanpool. Marketing messages can include cost savings, stress reduction, socialization, convenience, environmental reasons, other benefits.	Carpools usually have longer commutes than other modal alternatives, dramatically reducing VMT. Vanpools also tend to have lowest cost per passenger mile of any motorized mode of transport.	The more people who register, the more effective the program due to declining cost-to-scale. If few people participate, promotional efforts will be ineffective. Program should serve an entire geographic region to be successful.	Low (mode share); High(VMT reduction)	Low. Assumes promotion only

Source: Reference 16

Strategy	Description	Opportunities	Limitations	Effectiveness	Cost to Implement
Advanced traveler information systems (ATIS)	Offer commuters advanced information on availability of alternatives. Examples include kiosks at bus shelters informing patrons when next bus will arrive, online ride matching.	System success encourages new transit riders, providing up-to-date information on bus travel times. Helps allay transit rider fears, generated greater repeat travelers.	Can be expensive to implement, especially if monitors provided at all bus shelters. Best suited only for multimodal corridors, with limited effectiveness off of high-frequency transit corridors.	Medium (mode share); Medium (VMT reduction)	High
Bikes on buses promotion	Bicycles serve "last mile" connection between community or regional bus service and worksite or school. Promoting this connection often satisfies convenience factor associated by many commuters with using bus.	Bike storage on transit vehicles helps encourage new riders, especially if promoted with bicycle parking at worksite. Vancouver survey found that 30% of new riders were attracted specifically to bikes-on-buses.	Although bicycling helps extend market area for transit users, still limited to students and/or residences that are well-connected served by multi-modal corridors.	Medium (mode share); Medium (VMT reduction)	Low. Assumes only promotion costs, not actual provision of storage
Student or employee transportation coordinator	Employers dedicate representative and/or liaison to all students/ employees informing them of commute alternatives, availability of services or incentives at worksite.	Strong student or employee transportation coordinator is difference between "maximum" and "minimum" effectiveness of TDM.	Can be costly to maintain for small or medium-size employers.	Medium (mode share); Medium(VMT reduction)	Low to Medium

Source: Reference 16

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APPENDIX

B

Organizations Tracking Sustainability in Universities

Due to the growing interest in sustainability, several organizations have emerged that focus on a broad range of sustainability issues, including transportation. Other sustainability categories have included climate change and energy, food and recycling, and green buildings. Universities self-reported information and the "rating organization" evaluated the universities based on established rating criteria. According to the U.S. Department of Education's National Center for Education Statistics, there are 2,774 4-year public and private universities. (http://nces.ed.gov/programs/digest/d10/tables/dt10_275.asp). There are 560 universities that have participated in one or more sustainability-rating organizations.

Two sustainability rating organizations have provided much of the data on transportation modal splits for this report: the College Sustainability Report Card (CSRC), a special project of the Rockefeller Philanthropy Advisors (http://www.greenreportcard.org/), and the Sustainable Transportation Access Rating System (http://www.stars.aashe.org), developed in 2009 by the Association for the Advancement of Sustainability in Higher Education (AASHE).

The 2011 CSRC includes 322 university profiles that assess 9 different sustainability-related categories. In the transportation profile, universities self-report on policies and practices relating to their alternative transportation programs. In the 2011 report, 37 percent of universities were rated an "A" in transportation. These university profiles were reviewed to identify innovative transportation programs, modal split profiles, and other transportation-related information. Assessments are based on an A to F grading scale.

UNM did not participate in the 2011 report but did respond in 2010. The UNM/MRCOG Travel Demand Study [3] provides current information so that comparisons can be made. In 2010, UNM transportation was rated "B."

The Sustainability Tracking Assessment and Rating System (STARS) is sponsored by AASHE. STARS is also a self-reporting, points-based rating system and planning tool that was based on LEED and measures a university's progress in sustainability efforts. The STARS system includes environmental, economic, and social indicators, which are divided into five categories related to campus activities—education and research, operations, planning, administration and engagement, and innovation. Transportation is an element in the operations category. Universities are categorized as Registered (beginning to participate

but have not been rated), Bronze, Silver, Gold and Platinum. There are 212 universities that are participating in STARS.

Nearly 2,000 colleges and universities were contacted to participate in the *Princeton Review* of green universities, which included transportation as an element (http://www.princetonreview.com/uploadedFiles/Editorial_Content/Green_Material/Green%20Guide%20Complete%20full%20size.pdf). In 2010, Green Rating scores for 703 colleges and universities were tallied, and 308 schools were selected to be included in the *2011 Princeton Review's Guide to 311 Green Colleges* report. Of those, 18 schools attained scores of 99 and were named to its Green Rating Honor Roll.

Two other associations, Bicycle Friendly Universities (League of American Bicyclists) and Best Workplaces for CommutersSM (National Center for Transit Research at the University of South Florida), have developed rating systems that identify universities that have outstanding alternative transportation programs. Forty-five universities have been recognized by those programs.

Since its creation in 1990, the Association of University Leaders for a Sustainable Future (AULS) Talloires Declaration 10-Point Action Plan has "played a major role in raising awareness in the U.S. and around the world about the relevance of sustainability to higher education." The Declaration has been signed by 433 universities in 53 countries [33, 39].

APPENDIX

C

Snapshot of UNM's PATS TDM Programs

Initiative	Launch Date
Offers NM Rail Runner shuttle from UNM to downtown ATC station.	August 2006–present
Hires TDM Manager.	December 2006
Develops comprehensive alternative transportation info on PATS website.	April 2007
Hosts Alternative Transportation Fair.	April 2007
Bicycle Locker Rental Program; 50 lockers placed on Main and North campuses.	July 2007–present
Partners with AlterNetRides, online ride-matching service to encourage carpooling/vanpooling.	August 2007–present
Partners with VPSI, Inc., to develop vanpooling on campus; sustained East Mountain Vanpool for several months.	October 2007–April 2008
Administers 2007–2008 student ABQ Ride bus pass program.	2007–2008 Academic Year
Earns "A" in transportation for UNM on the Sustainable Endowments Institute 2008 College Sustainability Report Card (CSRC).	Published October 2007
Zipcar made available on campus; 5 cars placed between Main and North campuses. As of August 2009, only 3 Zipcars on UNM campus.	January 2008–present
Hires TDM Coordinator.	February 2008
Creates/distributes Alternative Transportation brochure.	March 2008–present
Creates LOBO Bikes, bike-share program funded by UNM world-of-wellness grant.	April 2008–present
Hosts Alternative Transportation Fair.	April 2008
Zipcar for UNM departments made available on campus.	June 2008–present
PATS participates in President Schmidly's Transportation Taskforce.	June–September 2008
PATS begins presenting information on alternative transportation at all UNM new employee orientations through UNM Human Resources NEO Program.	July 2008–present
PATS begins presenting information in-person on alternative transportation for all new students at Lobo, CEP, and TNT orientations.	June–August 2008, also in January 2009–present
Administers 2008/09 student, staff, faculty ABQ Ride bus pass program; 1st year that staff and faculty are eligible for program.	2008/09 Academic Year
Tire Pressure Tent Stations (part of fast-track clean-air awareness initiatives)	September–October 2008
"3 Ways to Improve Gas Mileage" video produced by PATS, published on UNM YouTube channel.	October 2008–present
Hosts Alternative Transportation Fair.	October 2008
PATS participates in the creation of University Bicycle Master Plan.	October 2008–present
Earns "A" in transportation for UNM on the 2009 CSRC.	Published October 2008
Clean-Air Coupons for oil/air filter service, emissions tests for all UNM faculty, staff, students.	February 2009–December 2010
PATS' Alternative Transportation Fair becomes UNM 1st Annual Sustainability Expo.	April 2009
PATS receives student funding for Transportation Information Center in Student Union Building.	June 2009
Develops/launches "Veggie Bus" powered by vegetable oil generated by campus food vendors.	August 2009
PATS administers 3rd year of ABQ Ride Free Bus Pass Program.	2009/10 Academic Year
PATS opens Transportation Information Center in Student Union Building.	November 2009–present
PATS plans and coordinates UNM 2nd Annual Sustainability Expo.	April 2010
PATS develops/launches 1st annual UNM Commuter Survey.	April 2010
PATS participates in regional transportation planning initiative led by MRCOG.	June 2010–present
PATS administers 4th year of ABQ Ride Free Bus Pass Program.	2010/11 Academic Year
PATS participates in regional transportation planning initiative led by MRCOG.	June 2010–present
PATS administers 4th year of ABQ Ride Free Bus Pass Program.	2010/11 Academic Year

Source: Transportation Demand Management Programs @UNM, University of New Mexico, Parking and Transportation Services, 2008. http://ldc.unm.edu/UserFiles/TransCommitteePres_083010_compressed.pdf

APPENDIX

D

UNM Shuttle Schedules

Appendix D includes UNM shuttle schedules for the UNM North, South, and Central campuses as well as the schedule for New Mexico Rail Runner.

Table D-1

Schedules for UNM Campus Shuttles

	Lobo Village Shuttle	Redondo Shuttle	T Lot Shuttle	C/Q Lot Shuttle	South Lot Shuttle
Description	Serves Lobo Village from Yale Mall, stops at Research Park	Serves North Campus from Duck Pond, connecting service with C-Q, South, T shuttles	Serves zone T, UNM Business Center from Dane Smith Hall	Serves G, Q, M from Duck Pond	Serves South Lot from Yale Mall
Monday–Thursday	6:30 AM–10:00 PM	6:30 AM–7:00 PM	6:30 AM–10:00 PM	6:30 AM–10:00 PM	6:30 AM–10:00 PM
Selected days and Fridays	Fridays: 6:30 AM–7:00 PM	Fridays; summer sessions, academic breaks: 6:30 AM–7:00 PM	6:30 AM–7:00 PM	6:30 AM–7:00 PM	6:30 AM–7:00 PM
Academic Breaks	May operate during academic breaks at reduced rate	6:30 AM–7:00 PM	6:30 AM–7:00 PM	6:30 AM–7:00 PM	No shuttle for summer sessions & winter break
Summer and Winter Breaks	Closed	Closed for summer break	Service to G lot for this period follows schedule above		

The New Mexico Rail Runner Express

The New Mexico Rail Runner Express (Rail Runner) is a commuter rail system operating between Belen (a bedroom community south of Albuquerque) and Santa Fe. First opened between Belen and Bernalillo (just north of Albuquerque) in July 2006, the system was extended farther north to Santa Fe in December 2008.

With a length of just under 100 miles, the system serves a total of 13 stations, including a stop at the ATC in downtown Albuquerque and another stop at the South Capitol location in Santa Fe, the workplace of a significant number of state government workers who reside in Albuquerque.

Current weekday ridership is approximately 4,500 one-way trips and about 3,500 one-way weekend trips. Weekday ridership includes commutes from both southern and northern locations to the ATC by UNM students; employees with shuttle bus connections to the UNM campus are detailed in Table D-2.

Additional information may be found on http://www.nmrailrunner.com/.

Table D-2

Schedules for UNM Shuttles to ATC Rail Runner (April 2012)

	UNM Campus Shuttle	UNM Hospital Shuttle
Description	Serves UNM Campus at Las Lomas/Yale to & from ATC. Operated by UNM PATS	Serves UNM Hospital Canopy to/from ATC. Operated by UNM Hospital
From Rail Runner to Campus	06:30 AM for Northbound train arriving at 06:03 AM and Southbound train arriving at 06:25 AM	06:25 AM for the Northbound train arriving at 06:03 AM and the Southbound train arriving at 06:25 AM
	07:31 AM for Northbound train arriving at 07:24 AM and Southbound train arriving at 07:26 AM	Leaves UNMH at 07:15 AM for Northbound train arriving at 07:24 AM and Southbound train arriving at 07:26 AM
		Leaves UNMH at 08:25 AM for Northbound train arriving at 08:58 AM and Southbound train arriving at 08:47 AM
From Rail Runner to Campus	06:30 AM for the Northbound train arriving at 06:03 AM and the Southbound train arriving at 06:25 AM	06:25 AM for Northbound train arriving at 06:03 AM and Southbound train arriving at 06:25 AM
	07:31 AM for Northbound train arriving at 07:24 AM and Southbound train arriving at 07:26 AM	Leaves UNMH at 07:15 AM for Northbound train arriving at 07:24 AM and Southbound train arriving at 07:26 AM
		Leaves UNMH at 08:25 AM for Northbound train arriving at 08:58 AM and Southbound train arriving at 08:47 AM
From Campus to Rail Runner	03:45 PM for the Northbound train leaving at 04:10 PM and the Southbound train leaving at 04:30 PM	03:45 PM for Northbound train leaving at 04:10 PM and Southbound train leaving at 04:30 PM
	05:05 PM for Northbound train leaving at 05:25 PM and Southbound train leaving at 05:45 PM	05:00 PM for Northbound train leaving at 05:25 PM and Southbound train leaving at 05:45 PM
		06:05 PM for Northbound train leaving at 06:30 PM and Southbound train leaving at 06:57 PM

Source: UNM Parking and Transportation Services, Shuttle and ATC/Rail Runner Schedules, http://pats.unm.edu/transportation.cfm.

APPENDIX

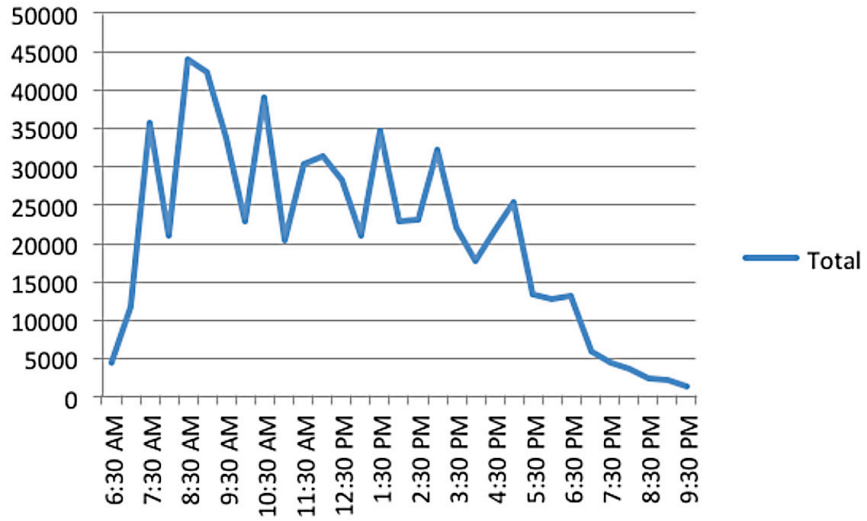
E

UNM Lobo Shuttle Ridership by Route

Figures E-1 through E-5 provide 2010 ridership data for each of UNM's parking lots.

Figure E-1

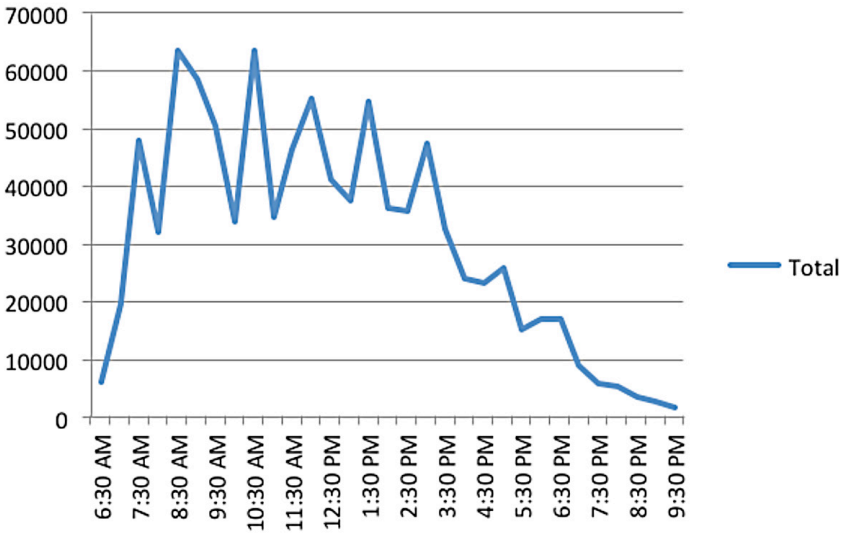
Lobo Shuttle G-Q Lots



Source: Reference 48

Figure E-2

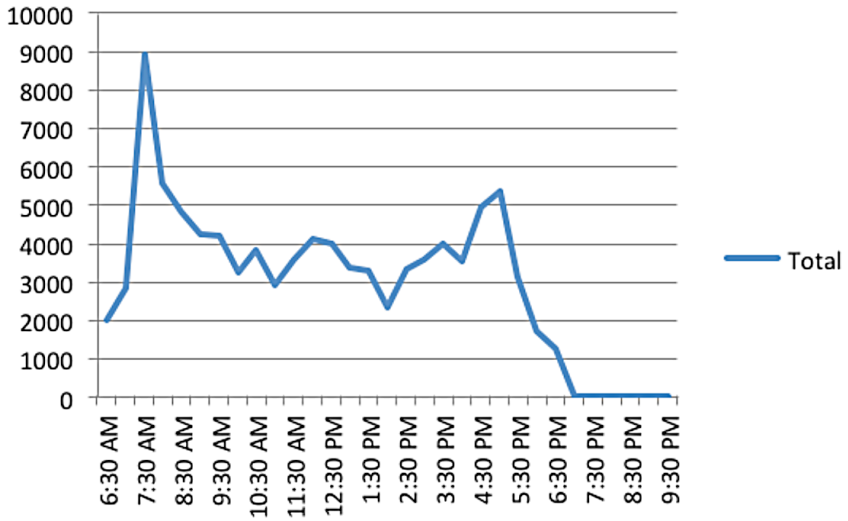
Lobo Shuttle South Lot



Source: Reference 48

Figure E-3

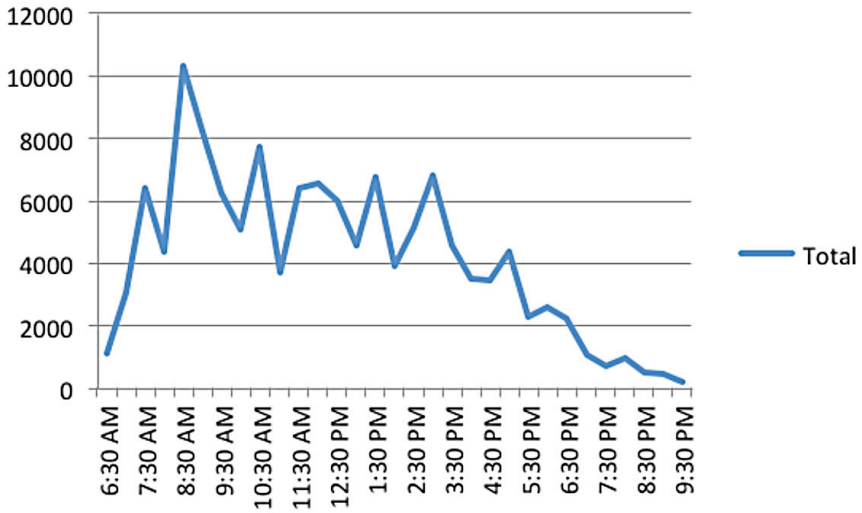
Lobo Shuttle Redondo Route



Source: Reference 48

Figure E-4

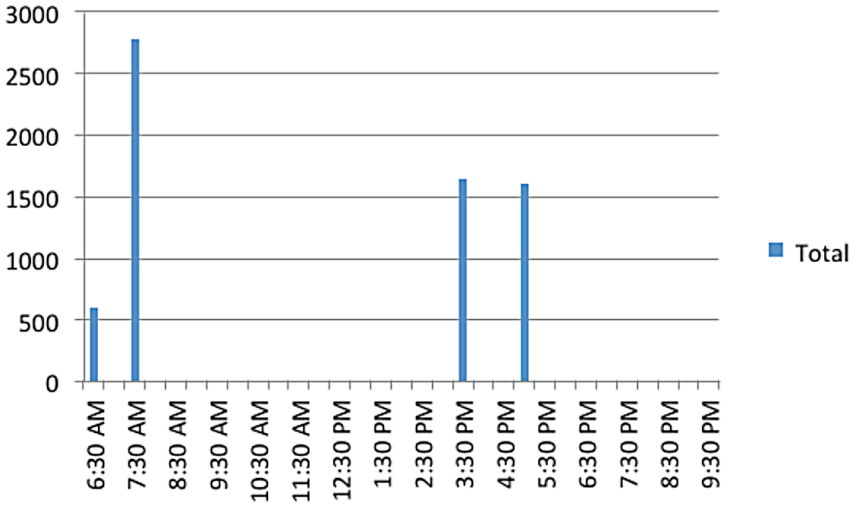
Lobo Shuttle "T" Lot



Source: Reference 48

Figure E-5

Lobo Shuttle ATC – Rail Runner



Source: Reference 48

APPENDIX

F

APTA Public Transportation and Universities Conference,

June 16–19, 2012, Fargo, ND

The following is a summary of the APTA Public Universities and Transportation Conference held June 16–19, 2012, at North Dakota State University (NDSU) in Fargo, which provided a great opportunity to network with those involved in university community transportation and participate in sessions that focused on university transit operations, partnerships, emerging technologies, marketing, and financing university transportation services. Attendees included large and small universities, transit providers, and vendors.

NDSU and MATBUS Operations

The MATBUS operation serves four universities in the Fargo area and operates with student drivers. It is committed to instill transit into the campus culture. MATBUS had 2.15 million yearly riders, with 1.1 million being NDSU students.

Marketing is by and with students and attempts to "speak the language of students" by using a MATBUS blog, Facebook, Twitter, YouTube, Flickr, and SMS/text alerts. "Hash tags" are used to receive, monitor, and respond to customer comments. Some marketing slogans include "MATBUS is healthy: burn calories not fuel" and "U-Pass cost = one tank of gas." Ads are made using NDSU students and NDSU colors.

Technology efforts to increase efficiencies efforts include electronic fare boxes, AVL locators, NSDSU kiosks with real-time data feeds, emitters for a green light signal priority project, automated paratransit scheduling, paratransit mobile data computers, and an auto voice announcement system. Google Transit is soon to be implemented.

UNM Presentation

UNM made a presentation titled "Enhancing Transit Utilization at Multi-Modal Universities" at the Transportation in Small College and University Communities session. Scot Weintraub from UC Davis discussed the operations of its student-operated Unitrans shuttle. Jim Brogan of UNM gave an overview of the project including profiles of the UNM campuses, Geri Knoebel discussed campus models at multi-nodal universities, and Danielle Gilliam concluded with presenting strategic collaborations at UNM. The presentation was well-received.

Workforce, Education, and Career Development Session

This session focused on the University of Massachusetts (Amherst) 2011 FTA Workforce Development grant for the development of a National Transit Curriculum. This modular, 15-credit-hour curriculum is not designed for transportation professionals but is intended for State DOT staff, planners, etc. Resources and assignments were being sought to round out the program as well as locations for internships. Samples of course modules were presented. The project is a joint venture with UMass Transit, CTT Transit (Hartford), and the UMass Transportation Center.

Table F-1

UNM Transit Operations Compared with Other Universities

University Observations from APTA Conference	UNM
Transit and other transportation services are separate operations at some universities.	Parking and transportation are under PATS umbrella.
A number of universities have student drivers/operations personnel (CSU, NDSU, UC Davis [170 student drivers & other roles, UCLA, UMass Amherst, Univ. of Montana, Univ. of Virginia). Often, student driver is highest paid campus job.	Shuttle drivers are unionized UNM staff.
Many universities fund shuttle services, alternative transportation through student fees (NDSU, UC Davis, Univ. of Illinois-Urbana, UMass Amherst, Univ. of Montana).	PATS funded solely through parking permits, parking enforcement fees. For first time in 3 years, parking permit fees increased, resulting in selling fewer parking permits, so no increase in overall revenue.
Shuttle operations are integrated with local city transit, which helps service coordination, makes operation eligible for federal funds such as for replacing buses (UC Davis, CSU, NDSU, Univ. of Illinois-Urbana, UT Austin).	UNM system operated solely for campus. Not eligible for federal funds, so has difficulty replacing buses from limited operational reserves. Ten years ago, purchased 10 buses through issuing bonds, which will need to be replaced in a few years.
Some universities do not allow any cars on campus (UCLA, Yale [undergraduates], Duke).	Dorms are on campus and vehicles are allowed for students; recent construction of on-campus housing will reduce 2,000 surface parking spaces.

Other University Innovations

- NDSU uses student-focused marketing with students who actually ride the bus; this involves 210 students whose names are used and identified as MATBUS Ambassadors. Marketing includes bus shelters, life-size banner stands for orientations, FAQs, billboards on and near campus, promotional products, and the use of QR codes. The University President is also included in ads. MATBUS allows the wrapping of buses with advertising.
- UC Davis has weekend service for dorms to shopping centers and other activities.

- The UCLA Bruin bus has 1.4 million yearly riders.
  - A special Saturday bus available for students to do shopping and for other activities; also, an evening van takes students to local entertainment.
  - Buses use AVL and have an application called "Know Before You Go."
  - The university conducts focus groups with students to talk about marketing and other related issues.
  - Social media are used to ask students to give feedback about quality of service. Interactive maps are available.

- The University of Illinois at Urbana will have all hybrid buses by 2016.
- The University of Massachusetts' UMass Transit serves four area universities and is a contract carrier with the Pioneer Valley Transit System; it has 12 routes with 2.7 million yearly riders and has been in business since 1969.
- UT Austin's shuttle operates as a part of Capital Metro.
  - The system serves 8M riders on 95 buses.
  - The Metro Rapid System is expected to become operational in 2014; this will significantly augment UT-related transportation.
  - Testing of a hydrogen fuel cell hybrid bus with zero emissions in underway; the fleet is also moving to all-electric vehicles.

- Yale's First Transit serves graduate students and employees only; undergraduate students live on a "self-contained" campus. The system operates 24/7 and has 40 vehicles with 25,000 to 30,000 rides per week. Transloc is used for mapping visualization.

ACRONYMS

APTA	American Public Transportation Association
AATA	Ann Arbor Transportation Authority
ASU	Arizona State University
ASUNM	Associated Students of the University of New Mexico
ATC	Alvarado Transportation Center
ATRI	Alliance for Transportation Research Institute
AVL	Automatic Vehicle Locator
AASHE	Association for the Advancement Sustainability in Higher Education
BBRP	Barbara and Bill Richardson Pavilion Outpatient Services
CNM	Central New Mexico Community College
CMAQ	Congestion Mitigation and Air Quality
CNG	Compressed Natural Gas
CSRC	College Sustainability Report Card
CSU	Colorado State University
FTA	Federal Transit Administration
GHG	Greenhouse Gas
ITS	Intelligent Transportation Systems
KM	Kilometers
LEED	Leadership in Energy and Environmental Design
MTB	Metropolitan Transportation Board
MRCOG	Mid-Region Council of Governments
NDSU	North Dakota State University
NMDOT	New Mexico Deprtment of Transportation
PATS	UNM Department of Parking and Transportation Systems
SOV	Single Occupancy Vehicle
STARS	Sustainability Tracking Assessment and Rating System
STC	Science and Technogy Park
TCC	Transportation Coordinating Committee
TCRP	Transit Cooperative Research Program
TDM	Transportation Demand Management
TMC	Transportation Management Center
TPTG	Transportation Program Task Group
TDM	Travel Demand Management
UNM	University of New Mexico

UNMH	University of New Mexico Hospital
UNM HSC	University of New Mexico Health Sciences Center
VMT	Vehicle Miles of Travel
UC Davis	University of California at Davis
UM	University of Michigan
USDOT	U.S. Department of Transportation
UT	University of Texas
UW	University of Washington

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