RIDESHARING, TECHNOLOGY, AND TDM IN UNIVERSITY CAMPUS SETTINGS:

Lessons for state, regional, and local agencies

May 2016

Prepared for:
U.S. Department of Transportation
Office of Planning, Environment, and Realty
Federal Highway Administration

FHWA-HEP-16-060

U.S. Department of Transportation
Federal Highway Administration

Foreword

This white paper and other resources related to ridesharing and transportation demand management (TDM), including two Federal Highway Administration (FHWA) companion reports on ridesharing are located on the Transportation Planning Capacity Building Program Website in the Congestion and Transportation Demand Management Focus Area. Readers may also be interested in TDM resources developed by the FHWA Office of Operations, which are available on the Office of Operations TDM webpage.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
05/03/2016	Final Report	September 2013 – May 2016

4. TITLE AND SUBTITLE
RIDESHARING, TECHNOLOGY, AND TDM
IN UNIVERSITY CAMPUS SETTINGS:
Lessons for state, regional, and local agencies

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER
51HW2LA300

5e. TASK NUMBER
NL452, NJ1P8

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Office of the Assistant Secretary of Transportation for Research and Technology John A. Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

8. PERFORMING ORGANIZATION REPORT NUMBER
DOT-VNTSC-FHWA-16-14

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Federal Highway Administration, Office of Planning U.S. Department of Transportation 1200 New Jersey Avenue, SE Washington, DC 20590

10. SPONSOR/MONITOR'S ACRONYM(S)
FHWA

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
FHWA-HEP-16-060

12. DISTRIBUTION / AVAILABILITY STATEMENT
No restrictions

13. SUPPLEMENTARY NOTES
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14. ABSTRACT
This report examines how university campus transportation departments are using new technologies and supportive polices to advance ridesharing and transportation demand management (TDM) as alternatives to driving alone to campus. It looks at university campuses as "ridesharing and TDM laboratories" where innovations may be first attempted in a relatively more controlled environment, from which elements could potentially be transferred to broader, more complex metropolitan transportation planning contexts. The report features case studies of successful ridesharing and TDM practices at six U.S. universities which have dramatically lowered drive-alone rates. In addition to the case studies, the report summarizes how ridesharing and TDM programs have factored into university transportation programs in the past, identifies and generalizes innovative practices from the case studies, and discusses how those practices may be applied in local, regional, or statewide transportation planning contexts.

15. SUBJECT TERMS
Ridesharing, ride sharing, transportation demand management, TDM, university transportation, campus transportation, metropolitan planning organization, state department of transportation, transportation planning, urban planning, parking management, social marketing, mobility management, alternative transportation, alternative mobility

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Lorrie Lau
FINAL	N/A	N/A	None.	84	19b. TELEPHONE NUMBER *(include area code)* (415) 265-2589

Contents

Executive Summary

University transportation departments are at the cutting edge of innovations in ridesharing and transportation demand management (TDM), incorporating new technologies and supportive polices to push past a theoretical tipping point where alternatives to driving alone become mutually-supportive and significantly more attractive. The universities examined in this white paper have been able to achieve drive-alone rates below 50 percent, with many showing dramatic reductions in their single-occupant vehicle (SOV) mode share of between 20 and 50 percent in recent years. This whitepaper examines six university transportation programs in detailed case studies conducted in 2014 and analyzes their approaches for relevance to State, regional, and local agencies, as well as peer university transportation programs.

The university programs examined include:

- **Massachusetts Institute of Technology (MIT)**
- **Stanford University**
- **University of California, Berkeley (UC Berkeley)**
- **University of California, Los Angeles**
- **University of Washington, Seattle**
- **Yale University**

While university programs operate under a significantly different set of constraints than State, regional, and local transportation agencies, their dramatic successes at reducing SOV travel and supporting commuters in using alternatives present potential useful models to be considered for applications through partnerships at other scales. In particular, there may be promising potential for metropolitan planning organizations (MPOs) in regions with SOV-reduction goals to leverage their position as regional-scale, multi-modal agencies to explore new partnerships with public and private sector partners.

This white paper summarizes the core elements of university transportation programs and provides a limited examination of how the university campus transportation environment compares with metropolitan and statewide transportation planning contexts managed by MPOs, State DOTs, transit agencies, and others. While acknowledging that universities have greater control over factors such as land use, parking supply and pricing, and financial incentives, the paper suggests that partnerships between public sector transportation agencies, the private sector, and others may have the potential to influence factors affecting travel behavior in similar ways.

This research presents lessons learned from examining six university transportation programs in five key areas, and discusses potential areas of application to non-campus settings. In each of these areas MPOs and their partners may find useful examples which could be adapted to a regional context and addressed through partnerships.

Active Parking Management: Universities leverage their control of on-campus parking resources to great success using tiered pricing, incentives for rideshare users, full lifecycle accounting, and other practices. These are often combined with new technologies that make accessing subsidies easier and which can provide new information on usage patterns to inform operations and policy making.

Social Marketing and Geographic Targeting: Because the majority of campus users are affiliated with universities either as faculty, staff, or students, the university transportation programs have the ability to reach a large percentage of commuters through existing communications channels. Some are innovating in this area by using social media and geographic targeting of communications, which can make messaging more effective.

Transit Agency Partnerships: Most universities provide some transit service, in the form of a circulator or shuttle bus. However, many leading universities have also developed close working relationships with regional transit providers to integrate fare card technology into university ID cards, share information, and establish innovative subsidy programs or new services design for campus users.

Integrating Mobility Options into a Single Package: Notably, universities have shown the ability to integrate programs and services in a mode-agnostic, performance-based approach to reducing SOV travel. Services are often bundled and branded as a mutually-supportive set.

Regional, State, and Local Polices and Partnerships: Like all large employers, universities exist within a local and regional context, and these relationships are important to them. In some cases, universities have formal agreements with local governments to cap or reduce SOV travel, creating a clear business need for the TDM program.

The potential for new technologies and policy innovations to improve the integration of ridesharing, TDM, transit, and other modes into a more attractive package is being demonstrated in university campus environments. Through these innovations, we see that under ideal conditions it is indeed possible to pass the theoretical tipping point where these coordinated alternatives become equally or more attractive than driving alone. Although they will undoubtedly be more difficult to implement at a regional scale, the integrated strategies presented by universities provide potential examples and food for thought, which MPOs and partners with SOV and congestion reduction goals may find useful. While significant barriers and unanswered questions remain about the potential to achieve these results outside of a campus environment; these techniques appear ripe for experimentation and application at district, city, and metropolitan scales.

Introduction

This white paper is the third in a series of FHWA white papers on the topic of advances in ridesharing resulting from technological and policy innovations. It highlights the notable successes of several university campus communities in expanding the use of alternatives to SOV travel and suggests ways in which their approaches might be translated to different scales by Metropolitan Planning Organizations (MPOs), their partners at State and local scales, and peer universities or other large employers.

Universities often embrace rapidly evolving technologies and policies related to ridesharing and other transportation options and have aggressively pursued TDM as a viable alternative to driving alone. As a result, they have been successful at reducing SOV mode shares while accommodating new campus development and at the same time maintaining positive relationships with local governments and adjacent neighborhoods, supporting environmental goals, and operating within business constraints.

This white paper profiles six university campus ridesharing and TDM programs where the combination of advances in technologies, creative partnerships, and supportive polices have resulted in extraordinarily dynamic commuting environments. The policies, practices and technologies utilized by these universities provide several useful lessons for application at regional and local scales.

Although implementation beyond the controlled environment of a university campus would likely be much more challenging, the experiences of these universities suggests that the success of a coordinated, holistic approach to ridesharing as part of a package of TDM and transit alternatives may justify the greater level of effort needed to implement a similar approach at regional or local scales. Because of their natural position as consensus-builders and conveners, MPOs may be well-positioned to coordinate efforts to bring local agencies, private employers, and others together to implement these strategies outside of a campus environment. Although MPOs have less direct control over land use, parking pricing, and other factors that universities use to influence transportation behavior, the university strategies featured in this report provide useful models for MPOs in regions with similar goals to consider.

University Campuses as Ridesharing and TDM Laboratories

The research for this white paper emerged from a hypothesis that university campuses are somewhat unique locations within the United States, with qualities that make them conducive to early adoption of new ridesharing technologies and policy innovations. Universities are useful laboratories for trying out new strategies and policies to reduce vehicle trips because they:

- Have greater control over land use than MPOs, or state and local agencies;
- Control parking supply, which they often highly constrain and price (permitted or otherwise);
- Provide campus transit systems and often have relationships with regional transit providers;
- Typically have a core campus that is pedestrian oriented rather than automobile oriented;
- Have younger, more experimental communities with populations who are more likely to be early adopters of new technology;
- Have a constrained development footprint which drives up the value of campus real estate;
- Typically offer extensive ridesharing and TDM programs with staff support.

These qualities should theoretically help university communities to be some of the first to reach the "tipping point," where ridesharing and other alternatives are viewed as equally or more attractive than car ownership and SOV travel for a large subset of the community.[1] The profiles of leading universities in this white paper demonstrate that many of them have indeed achieved remarkable success at lowering SOV trips in a relatively short time period, and have proven that it is possible to reach the tipping point of mobility parity through a coordinated and mode-agnostic approach to transportation planning and operations. Their success is cause for us to pay attention to the package of policies and technologies that these universities employ to simultaneously reduce driving while accommodating increased development, often within largely auto-oriented metropolitan areas.

As opposed to supplying extensive transportation alternatives, ridesharing requires little in terms of dedicated infrastructure or advanced planning because, for the most part, it utilizes the existing roadway and parking infrastructure. Therefore, even modest increases in the use of ridesharing produce enormous benefits relative to their cost. Because of several characteristics that most of them share, university campuses are perhaps a unique laboratory for examining the potential for this tipping point to manifest. As such, we hypothesized that university campuses would be where the potential for these new, innovative technologies and polices would first be observed and measured. And indeed, we found that leading campuses have experienced dramatic results.

This research project involved a review of campus ridesharing and TDM programs, and in-depth research on the approaches of six leading university campus transportation programs. These six universities all maintain active ridesharing and TDM programs that explicitly seek to reduce SOV travel and they have achieved significant reductions in drive-alone commuting to campus. They were able to do this, not so much because of major increases in transit service (although some did increase transit options), but more so through offering a coordinated package of transportation options, utilizing emerging technology, and adopting internal land use and parking supply policies that supported the use of alternatives to driving alone, including ridesharing, transit, bicycling, and walking. Each campus profiled has achieved far lower rates of commuters driving alone than is average in their metropolitan areas (Table 1). This is despite their position as major regional employers with broad commute sheds that draw commuters from a variety of areas, both local and distant.

Table 1: 2014 SOV Commute Rates for Case Study Campuses Compared to the Metropolitan Area

University Campus	Campus	Metropolitan Area
Massachusetts Institute of Technology (MIT)	21%	70%
Stanford University	49%	72%
University of California, Berkeley (UC Berkeley)	17%	72%
University of California, Los Angeles (UCLA)	36%	78%
University of Washington, Seattle (UW)	18%	73%
Yale University	38%	82%

SOURCES: University transportation staff; and 2013 American Community Survey Estimates (Table B08101)

[1] See the FHWA Office of Planning report Moving Together in the 21st Century: How Ridesharing Supports Livable Communities for more detailed discussion of the "tipping point."

Those universities that offered historical commute data[2] also show that they have achieved remarkable success at reducing their SOV rate since expanding and refining their TDM programs, utilizing emerging technology, and adopting policies supportive of ridesharing, transit, bicycling and walking (Table 2). These gains are perhaps even more remarkable when put in the context of national commuting trends, because nationwide SOV mode share increased from 73 percent in 1990 to over 76 percent in 2010[3]:

- **Stanford University** sharply reduced its drive alone rate from 72 percent in 2002 to just 49 percent in 2014 (a 32 percent decline), with commuters switching mostly to commuter rail and bicycling.

- **MIT** reduced its drive alone rate from 27 percent in 2002 to 21 percent in 2014 (a 22 percent decline), while witnessing increases in the use of ridesharing and other alternatives.

- **UC Berkeley** reduced its SOV rate by faculty and staff from 60 percent in 1990 to 43 percent in 2014 (a 28 percent decline); and reduced driving alone among students from 16 percent in 1990 to only 5 percent in 2014 (a striking 69 percent decline from an already low rate). Walking and bicycling now comprise the majority of trips to and from UC Berkeley's campus.

- **UW** reduced its SOV rate from 34 percent in 1990 to only 18 percent in 2014 (a 53 percent decline), mostly through dramatic increases in the use of public transit since offering the U-Pass, and increases in walking and bicycling.

- **UCLA** managed to reduce the number of cars entering the campus by 20 percent between 2003 and 2014 while at the same time expanding development and accommodating more commuters. UCLA commuters utilize ridesharing, public transit, and bicycling to a greater degree than the wider community.

Table 2: Change in Key Drive-Alone Metrics for Case Study Campuses[4]

University Campus	% Decline	Metric	Time Period
Stanford University	32%	SOV rate	2002-2014
Massachusetts Institute of Technology (MIT)	22%	SOV rate	2002-2014
University of California, Berkeley (UC Berkeley)	28%/69%	SOV rate for faculty and staff/for students	1990-2014
University of Washington, Seattle (UW)	53%	SOV rate	1990-2014
University of California, Los Angeles (UCLA)	20%	Number of cars entering campus	2003-2014

SOURCES: University transportation staff

[2] Historical commuting data for Yale University were not available.
[3] Commuting in America 2013, American Association of State Highway and Transportation Officials
[4] Historical commuting data for Yale University were not available.

Summary of Prior FHWA Ridesharing and TDM Reports

The preceding report in this series, "Moving Together: Ridesharing in the 21st Century: How Ridesharing Supports Livable Communities," introduced the concept that advances in technologies and policies related to ridesharing and other commuting alternatives may in some places be leading us toward a "tipping point," at which alternatives to driving alone become equally or more attractive than SOV travel. This tipping point may be an important milestone for supporting more efficient land use patterns, which contribute to vibrant livable communities. The report discussed how the growth of both ridesharing and carsharing may be leading real estate developers and city planners to reconsider the allocation of parking spaces, which has impacts on housing density and livability, as well as leading some residents and commuters to reconsider both the costs and the necessity of vehicle ownership.

The first report in the series, "Ridesharing Options Analysis and Practitioners' Toolkit" introduced several technologies that are changing the ways that people participate in ridesharing. The internet and smart phones have proven to be major transportation innovations and they have moved us far beyond the days of ridesharing message boards and carpool clubs. Technology is evolving rapidly but some notable examples of the technologies that have proliferated in recent years include:

- Smartphone applications that integrate transportation options (e.g. Ridescout[5], Google Maps[6])
- Parking technologies and polices (e.g., demand-responsive pricing, "pay by phone" technology)
- Online or Dynamic Ridematching services (e.g. Carma,[7] NuRide,[8] Zimride[9])
- Integration of transit passes or other transportation services with ID cards (e.g., U-Pass[10])
- Vehicle sharing technology (e.g., Zipcar,[11] Enterprise,[12] RelayRides,[13],local carsharing)

A related report, "Developing a Regional Approach to Transportation Demand Management and Nonmotorized Transportation: Best Practice Case Studies," describes how some MPOs have incorporated TDM and nonmotorized transportation as key modes in the metropolitan transportation planning and programming processes, demonstrating a holistic, regional approach to TDM. The four MPOs profiled in that report each recognize the importance of TDM in supporting regional goals of reducing driving to congested locations and their example suggests the potential for a greater role for MPOs throughout the country to provide leadership and support on TDM activities. It offers several potential examples for how MPOs might begin to address ridesharing and TDM at regional and local scales, which complement the university strategies presented in this white paper.

[5] http://www.ridescoutapp.com/
[6] http://maps.google.com
[7] https://carmacarpool.com/
[8] http://www.nuride.com/home.php?t=home
[9] https://www.zimride.com/
[10] http://www.washington.edu/facilities/transportation/student-u-pass
[11] http://www.zipcar.com/
[12] http://www.enterprisecarshare.com/
[13] https://relayrides.com/

Research Approach

The primary objective of this research was to explore and draw conclusions from the experiences of university campus ridesharing and TDM programs that may be of use to MPOs and their partners, who are exploring options to implement a wider range of mobility options that reduce the need for major transportation infrastructure expansions and support existing transportation investments. This objective arose from a hypothesis that MPOs and state and local transportation agencies could benefit from insights gleaned from university campuses as "laboratories" for exploring implementation of new ridesharing technology and policies as part of a balanced approach to TDM. A second objective was to provide relevant examples for peer universities and other large employers.

The research approach for this report began with a review of existing literature about ridesharing as part of university TDM programs. The research team also consulted with staff from the Association of Commuter Transportation (ACT) about the characteristics of university ridesharing and TDM programs, and to help select case studies candidates that could provide a snapshot of innovation by universities. The project team reviewed available electronic and print resources on these programs and conducted follow-up discussions with their staff. The following six universities agreed to be featured as case studies in this white paper:

- **Massachusetts Institute of Technology (MIT)**
- **Stanford University**
- **University of California, Berkeley (UC Berkeley)**
- **University of California, Los Angeles**
- **University of Washington, Seattle**
- **Yale University**

These six case studies were conducted in 2014 and informed the synthesis, analysis, and conclusions included in the body of this white paper. The case studies are presented in full at the end of the document, in Part IV.

Organization of White Paper

This white paper is organized into four parts:

- **Part I: Ridesharing Technologies and Policies in the University Campus Context,** summarizes the components of typical university TDM programs and their transportation and land-use contexts. It includes a discussion of how universities are unique environments for TDM and compares them to other types of public and private organizations with roles in the overall transportation sector.

- **Part II: Lessons from University Successes in Ridesharing and TDM,** presents a synthesis of findings from the six case studies that may be relevant to MPOs, their local and state partners, and peer universities or other large employers. This section discusses five elements of university ridesharing and TDM programs that have led to success among the case studies profiled in this white paper. Each of these elements includes potential lessons and opportunities for MPOs and their partners.

  The five elements featured in this section include:
  - Active Parking Management
  - Social Marketing and Geographic Targeting
  - Transit Agency Partnerships
  - Integrating Mobility Options into a Single Package
  - Regional, State, and Local Policies and Partnerships

- **Part III: Conclusion,** summarizes the potential of the policies and technologies employed by leading universities to be applied in regional and local contexts, and discusses possible avenues for future research and exploration of the topics discussed in the white paper.

- **Part IV: Case Studies of University Transportation Programs,** presents detailed profiles and discussion of the six university campus TDM programs which provide the basis for the analysis in this white paper. Each case study includes statistics and trends in campus commuting, a description of the campus local and regional context, an overview of transportation programs offered, and lessons learned from notable practices employed by these institutions. The case studies were conducted in 2014.

Part I: Ridesharing Technologies and Polices in the University Campus Context

Much like many other large employers do, universities provide a mix of transportation services to support alternatives to SOV commuting. Universities also provide options for on-campus and inter-campus transportation. However, unlike most employers, universities also typically have large off-peak transportation demand for major events and late or early campus activities. They also tend to value keeping classes and administrative functions centralized in or near their main campuses, as opposed to spreading operations out across the country or the world, and they cannot easily move operations from one place to another. In these ways, universities are unique large employers who value place and real estate highly. Because they are tied to their locations, they share many of the same qualities as cities, business improvement districts (BIDs), and downtown development authorities (DDAs). These characteristics make them interesting case studies in transportation service provision and problem solving.

Elements of University Transportation Programs

Universities have long had active TDM programs, which have evolved over time with the needs of campus populations. Many universities were founded in an era before auto mobility, and have worked to preserve a traditional, walkable campus setting. Traditional campus designs are also conducive to typical day-to-day operations of universities, where students, faculty, and staff often travel between buildings several times throughout the course of a day. In recent decades, many universities have worked hard to provide a balance of transportation options that allows for convenient regional access, but which also enables the campus to accommodate new development and increases in enrollment and which support environmental sustainability goals.

University transportation programs typically include many of the same core elements. In a 2008 survey of 29 higher education institutions, the University of South Florida's Center for Urban Transportation Research (CUTR) and the Association for Commuter Transportation (ACT) found the following transportation program elements were provided to university students or employees at 50 percent or more of the institutions surveyed:

- Bicycle paths or lanes (on or off road)
- Park and ride lots with transit/shuttle service to campus
- Free or discounted transit pass/fares
- Bicycle registration
- Guaranteed/emergency ride home service

However, the CUTR/ACT survey and our own case study research show that many universities use additional alternative transportation strategies as well. In particular, leading institutions tend to use some combination of the following:

Ridesharing

- Online ridematching services for carpools and vanpools
- Vanpool subsidies

Parking

- Discounted or preferential parking for carpools and vanpools
- Tiered parking permit structures based on location and time-of-day
- Park-and-ride lots with transit or shuttle service to campus

Transit

- Campus shuttle or circulator
- Free or discounted regional transit pass

Nonmotorized transportation facilities

- Walkable campus design
- Bicycle paths or lanes (on- or off-road)
- Bicycle registration
- Covered or secure bicycle parking and maintenance stations
- On-campus bike share locations and subsidized system membership

Miscellaneous

- Marketing, promotion, and individual and group outreach
- On-campus carsharing vehicles and subsidized system membership
- Guaranteed/emergency ride home service
- Membership in transportation management organizations (TMOs)

Differences in Influence over Transportation Alternatives: Universities as Compared with Others

Universities have a somewhat unique level of control over the mix of transportation and land use alternatives available to campus users. This is in contrast to other common planners and providers of transportation services, such as MPOs, State Departments of Transportation (State DOTs), transit agencies, cities, transportation management organizations (TMOs), and others, which each control different aspects of the overall transportation picture. This section compares the context of university transportation programs with these others, illustrating how universities have an advantage in developing coordinated transportation programs, but also showing that MPOs, State DOTs, and others have the potential to work together outside of the campus context. As illustrated in Table 3 below, MPOs and their potential partners may be able to influence or guide an even greater spectrum of factors affecting travel behavior than universities, when working together toward common goals.

Table 3: Control or Influence of Universities and Others over Factors Affecting Travel Behavior

●	Full control/strong influence
◒	Partial control/influence
○	Little or no control or influence

	University	State	MPO	City	BID or DDA	Regional Transit Agency	TMO	Other Employers
Land-use regulation or control	●	○	◒	●	◒	○	○	◒
Parking supply and price	●	○	○	◒	◒	◒	◒	●
Regional transportation network	○	●	●	◒	○	●	○	○
Transit fares and service	◒	○	○	◒	○	●	◒	◒
Highway tolls/pricing	○	●	○	◒	○	◒	○	○
Financial incentives or other rewards	●	○	○	○	◒	○	◒	●
Trip-reduction or vehicle emissions regulations	○	●	◒	●	○	○	○	○
Social marketing, individual, and group outreach	●	○	◒	◒	●	●	●	●

Universities

Because they are major employers and because they tend to have control over large, contiguous areas of land, universities are in a unique position to pair land-use planning and transportation planning -- at least at the local level. Universities are influenced by local land-use regulations (particularly parking and trip-reduction regulations), but they largely control how their land is developed. One notable result of this is that the majority of university campuses provide little or no free parking to regular users. In part because of this strong influence over parking, they are also able to provide financial incentives or other rewards to employees to use alternative modes. Universities often provide some on-campus transit services and they commonly have connections to regional transit service. They have robust marketing and outreach programs, often associated with new employee and student orientation, which help inform users of the services provided, incentive programs, and the benefits of using alternative transportation modes.

States

The role of most State DOTs and other State-level transportation agencies is to provide a statewide network of highways and other transportation modes. They coordinate with agencies at metropolitan and local scales. They have strong influence over long-distance transportation routes in the State and over tolling and managed highway lane pricing decisions. They typically have little or no involvement in parking policies, transit fares (transit is typically provided by local or regional agencies), or land-use

regulation. State-level polices that include trip reduction or emissions reduction requirements or targets sometimes have a big influence on MPOs, local governments, and employers.

Metropolitan Planning Organizations (MPOs)

Planning the regional multimodal transportation network and developing the Federally-funded program of projects are the core responsibilities of MPOs. In these roles they coordinate closely with local jurisdictions and with the State, and are often key leaders in addressing existing and future transportation issues. The implications of regional and local land-use regulation for regional transportation is a common topic of concern for MPOs, but they rarely have land-use planning authority, nor do they set parking policies. Some MPOs have begun to use social marketing[14] and outreach to promote regional TDM strategies, such as ridesharing and non-motorized transportation.[15] A key role for MPOs is to program Federal funds to local and statewide agencies to implement regional transportation plans, and to develop plans for the metropolitan area-wide multimodal system. Because they are coordinators of planning for multiple agencies and local governments, they are in a unique position to institute innovative partnerships to further regional priorities for transportation and sometimes land use. Travel demand management is one program area where MPOs can provide leadership, develop goals and programs, and establish partnerships to meet their goals or implement statewide policies.

Cities and Counties

Cities and counties own and operate local transportation assets (e.g., local roads), including on-street and off-street parking. In most States cities have primary land-use regulatory authority, which often includes off-street parking requirements for private developments. Local policies, laws, and regulations have a big influence on universities and other large employers. Some local governments operate local transit services directly through city or county government, although most regional and high-capacity transit services are provided by special-purpose regional agencies. Local governments have traditionally provided limited marketing and outreach for commuting alternatives.

Business Improvement Districts (BIDs) and Downtown Development Authorities (DDAs)

BIDs, DDAs, and similar special-purpose local entities focus on downtowns, corridors, or other dense areas of commercial activity. They are sometimes involved in transportation planning or operations. Some of these agencies own or coordinate parking facilities and set prices. Some have influence over land use (typically based on preservation of walkable or historic character). They tend to represent the interests of the business owners in the district in interactions with local and state governments, including on transportation issues, particularly those related to parking and transit. Like universities, they have a focus on users of a small geographic area some of whom live nearby and others of whom

[14] Social marketing is based on a theory that misperceptions or lack of awareness and information leads to lower usage of alternative transportation modes. The concept has been piloted and applied in several areas worldwide, including in Washington State. http://docs.lcog.org/PDF/ODOTTravelSmartFinalReport.pdf

[15] See the FHWA Office of Planning report: Developing a Regional Approach to Transportation Demand Management for examples and more information

live in distant locations. Many of these organizations have robust marketing and outreach programs that can be used to promote TDM programs like ridesharing.

Regional Transit Agencies

Many major metropolitan areas have a regional transit authority which either coordinates or provides high-capacity and local transit service throughout the region. These agencies work closely with cities and other local governments, MPOs, and state agencies to plan and deliver regional transit services. In many cases, transit agencies provide park-and-ride lots to increase motorist access to the transit system. Transit agencies control the fare price structures of the system (sometimes with State oversight or subject to public referendum). Agencies that provide regional bus service may coordinate with States on tolling and managed highway lane polices which speed-up services that run along major highways. Nearly all transit agencies use marketing techniques to advertise their services and provide trip planning assistance, and some offer rideshare services in addition to providing regular transit service.

Transportation Management Organizations (TMOs)

Many large metropolitan areas have one or more TMOs, which serve employment centers or residents of particular neighborhoods. These organizations provide commuter services much in the same way that universities and other large employers do, such as ridematching, guaranteed ride home services, personalized trip planning, and others. Some TMOs provide incentives or rewards to their members for using alternative modes. However, TMOs do not typically own or operate parking or other transportation assets. They are stakeholders in the regional transportation planning process, and are often partially funded by cities, MPOs, or States. TMOs are usually funded by a mix of fees paid by member businesses, combined with Federal sources like the Congestion Mitigation Air Quality (CMAQ) program. Social marketing and individual or group outreach is a major focus of most TMOs, much like university programs.

Other Employers

Universities are a unique type of large employer, but in many places other large employers also provide transportation services and benefits to their employees. The most common benefit is a hidden subsidy for automobile transportation: free off-street parking. In areas with constrained parking supply, employers may charge their employees for parking and they may provide similar types of incentives as universities do to encourage employees to use ridesharing and other alternatives. When employers provide these services they tend to pair them with communications and marketing efforts that try to engage employees and help them choose less expensive or more sustainable transportation options. Because employers own or lease land, they often have the power to decide how land is developed (within local land-use regulation constraints), with significant implications for employee transportation options (e.g., parking polices, transit accessibility, and nonmotorized transportation facilities).

Part II: Lessons from University Successes in Ridesharing and TDM

Transportation management activities by universities offer a distinct approach to transportation and land-use challenges that span other similar contexts. Universities have a clear business need to hold the demand for parking spaces to a minimum so that scarce campus land can be put to more productive uses. Thus they have been compelled to innovate using different aspects of their limited authority to encourage affiliates of the university to rideshare, walk, bicycle, and use transit to reach campus. Other planning actors, like MPOs, State DOTs, cities, and BIDs share this aspiration to increase economic activity while reducing vehicle trips. This section includes a discussion of notable features of successful strategies employed by university transportation programs, and how they might hold lessons for other types of transportation planning agencies.

Notable features of successful university strategies that could be explored by MPOs, State DOTs, and their partners include:

- **Active Parking Management:** Nearly all large universities offer variable rate pricing and incentives for carpools and vanpools. Some of the most innovative institutions also incorporate full lifecycle cost accounting into university business practices regarding the provision or management of parking.

- **Social Marketing and Geographic Targeting:** Many universities have started commuter clubs that allow them to improve marketing efforts to individuals who join them, and to target communications and programs to groups based on location, for those who provide information about their home location, transportation needs, and preferences.

- **Transit Agency Partnerships:** Partnerships with regional transit agencies have been able to improve the level of service the university receives and increase their influence over transit operations and service planning.

- **Integrating Mobility Options into a Single Package:** Each transportation option has individual benefits, but put together and managed in complementary ways they have potential to become a new integrated mode consisting of many constituent parts which together may be as attractive as private vehicle ownership.

- **Regional, State, and Local Policies and Partnerships:** A handful of the most successful universities were spurred into action to reduce trips from the establishment of trip-reduction or development requirements by state, city, or county governments. Universities have also been a progressive resource for cities that wish to improve transportation options and address environmental sustainability goals.

These features of successful strategies can be applicable to multiple scales and contexts outside of a university campus environment. The following section summarizes these strategies and presents ideas for how they might be considered by MPOs and partners in a wider regional, city, or business district context.

Active Parking Management

Difficulties providing parking are often the primary motivating force for universities to incentivize alternatives to SOV travel. Parking is a problem for universities because it requires a lot of available land or the building of expensive multi-decked structures. Because the largest, most established universities are typically constrained by development that has grown up around them, they are forced to expand through redevelopment of infill sites or underused buildings. Parking lots and structures are also often used as land banks for universities to accommodate these expansion needs. However, this practice poses a clear problem as universities simultaneously increase travel demand through the addition of new buildings, while simultaneously eliminating parking spaces.

University Parking Management Innovations

- *Using full lifecycle cost accounting in parking decisionmaking*
- *Variable rate parking with subsidies for rideshare users*
- *Using revenues and opportunity costs from parking to support alternatives*
- *Using new technologies to make providing incentives easier, and to gather better data on parking utilization*

Features of university campus active parking management strategies

Because parking demand can present an impediment to growing universities, some have adopted practices that make the full lifecycle cost of providing parking transparent in decisionmaking regarding campus facilities. Both Stanford University and MIT account for the cost in different ways.

Stanford does not provide parking for all of its new development. Instead, the university builds fewer parking spaces, and redirects some of the funds that would have been spent on them to the campus's alternative transportation program. Stanford has even gone so far as to pay employees who use ridesharing or other alternatives up to $300 per year in "clean air cash," a practice it can partially justify because of its awareness of the full cost of providing parking on a land-constrained campus. Similarly, MIT has calculated an average $100,000 lifecycle cost of each parking space, an accounting practice that affects many of its decisions regarding parking, including how much to provide in a new development, how important it is to manage it effectively, and the value of incentivizing alternatives to driving alone. One notable feature of MIT's parking management is a pilot program to provide purchasers of full-time parking permits with a transit pass, a practice that has been shown to entice even regular drivers to occasionally use transit.

There are various strategies that universities use to actively manage parking. A common practice among the universities profiled in this report is to charge a lower rate for carpools than for single-occupant

vehicles, and to provide free parking for vanpools. This results in significant savings per occupant because the lower rate is also split among all passengers in the vehicle, resulting in much lower per-person parking rates. Universities also employ pricing strategies like charging different rates for different parking areas based on demand, adjusting rates during busier times, providing parking attendants in particularly busy lots, and employing new technology to provide drivers with better information about parking availability and to more easily provide incentives such as those mentioned above.

Some examples of new technologies that are changing the ways universities manage parking and ridesharing incentives include:

- The University of Washington (UW) piloted a system that used a card reader to let carpools receive the discounted parking rate without pre-registration. The system automatically billed users via their university ID card. If two ID cards were swiped in succession then the discounted rate was applied and split between them.

- The University of California, Berkeley (UC Berkeley) uses a parking payment vendor – PayByPhone – to collect parking fees for public parking spaces on campus. The system enables users to pay for parking via smartphone instead of using cash or pay stations. It also provides the university transportation staff with valuable information on parking utilization trends.

- MIT is exploring a parking application which would allow users to reserve and pay for parking spaces through their smartphones. The Institute is interested to see if such a system could reduce traffic congestion by providing travelers with information about available parking spaces in various locations. The application would also provide the transportation staff with valuable information on travel behavior and parking utilization.

Using parking as the cornerstone of a mobility management strategy may be particularly effective because parking revenues can be fed back into the program, in effect, subsidizing the trips of those who arrive as passengers or drivers in a carpool or vanpool, or those who take advantage of reduced-fare transit passes. These revenues may come from charging higher prices to SOV drivers or by accounting for the lifecycle savings of avoiding the cost of new parking facilities.

Potential applications of active parking management strategies in other contexts

Local government policies and practices often treat parking as a good that must be provided to meet an inherent demand, without a full recognition of the effects that the price of parking have on travel behavior. They do this by establishing parking requirements for different land uses or by providing public parking garages, lots, and on-street parking at lower than market rates. States and MPOs frequently leave parking considerations to local governments or the private sector and instead focus resources and planning around investments in highways, transit, and nonmotorized transportation facilities for regional or statewide benefit.

The experiences of universities offer a different approach to the consideration of parking, which is demonstrating interesting results. These universities actively manage parking supply and demand and

account for the full lifecycle cost of providing parking because they value their land so highly and because it affects their bottom line. Parking lots and structures are a by-product of auto mobility. They provide few benefits by themselves, but are a necessary requirement of auto travel. By including the costs of providing parking in university transportation decision making – both the monetary costs of construction and ongoing maintenance, and the opportunity cost of not using that land for a more valuable purpose –these institutions have attempted to correct a hidden subsidy that favors automobile travel over other modes. In the campus setting, universities pay that subsidy. However, in the regional or municipal transportation context, the traditional, passive approach to parking management likely results in higher demand for SOV travel than would occur if drivers paid the full cost of parking.

Many downtown business districts and employment centers in the United States struggle with providing enough parking to meet demand while still making efficient use of land. Where land values are particularly high there may not be enough available parking, stifling new development and driving up demand for major high-capacity transit investments and parking structures. When regional and municipal planners wish to increase development in activity centers like downtowns or other business districts, developing land currently dedicated to parking is often one of the only options. However, to do so likely requires a more active parking management approach. Particularly in regions and cities with high and increasing real estate values, active parking management may enable a more complete realization of development potential.

Because universities are self-contained, it is less complicated to manage parking and account for its costs than in a municipal or regional context where many public and private organizations control parking supply and pricing. To transfer the active parking management concept to a metropolitan, city, or district scale, these organizations might seek to develop a common methodology for determining the full lifecycle cost of providing parking spaces in specific focus areas and work with the owners of parking spaces (both public and private) to adjust prices in a coordinated manner.

There are many possible ways to apply active parking management principles to regional and city planning and programming activities. For instance, San Francisco recently piloted the SF Park program, in which demand-responsive priced parking meters substituted traditional parking meters and traditional public parking garages were switched to a variable rate structure in certain high-demand areas. Under the SF Park program, the parking rates vary by block, by time-of-day and by day-of –the-week, based on how much they are being utilized. The program evaluation determined that average parking rates actually went down, parking availability improved, and traffic resulting from drivers searching for parking declined. This approach is being applied in other cities as well, including the business district near UCLA in Westwood, Los Angeles and in Berkeley, near UC Berkeley. Because drivers can pay for these smart parking meters by phone, one could imagine an extension of the tool that would provide a parking discount if the fee is split between two or more vehicle occupants, providing a subsidy to rideshare users much like those provided by university programs.

Regardless of the specific mechanism used, the experiences of university transportation programs show that the pricing and supply of parking can be actively used as a tool to further SOV-reduction goals. These policies may be transferable to a metropolitan, city, or district scale to encourage ridesharing and

other non-SOV travel modes, thereby lowering parking demand and freeing-up scarce land in dense districts for more productive uses.

Social Marketing and Geographic Targeting

Many of the universities profiled in this report have a commuter club or similar association through which the university transportation program delivers messaging and programs. Some others use geographic information systems (GIS) technology to help them target outreach efforts to the most relevant community members. The ability of university transportation programs to effectively target and reach members of their communities has been greatly enhanced by the use of information and social media technology in the last several years.

Features of university campus social and geographic marketing

UCLA, for example, offers members of its Bruin Commuter Club exclusive benefits related to commuting, and opportunities to participate in contests and other social activities with prizes. Stanford has a similar program and offers games that challenge members to use alternative modes of transportation or to commute to campus at off-peak times.

By enlisting members into commuter clubs, university programs can more easily reach their communities with announcements, alerts, and targeted information on transportation alternatives.

Members of commuter clubs can receive information through links to university-based and common social media outlets. Social media applications like Zimride's ridematching service, which links users to their Facebook profiles, have allowed potential carpool partners to instantly see who their fellow riders are and what their social connections to them might be. When combined with a closed community such as a university, they can help overcome trust barriers associated with traditional ridesharing arrangements. While social media seems to hold promising potential for increasing ridesharing, most university programs have limited understanding of their effects; the most common 3rd party ridematching systems do not allow universities to easily track how often successful rideshare matches made through the systems actually lead to successful carpools.

University Social and Geographic Marketing Innovations Include:

- *Commuter clubs to promote programs and overcome trust barriers*
- *Games and contests to engage community members and incentivize non-SOV travel*
- *Using GIS to target messaging to specific neighborhoods, corridors, or community members with relevant characteristics*

Geographic targeting makes it easier to reach commuters with the right kind of message and options. Many of these programs use GIS and database technology to target communications with members based on certain attributes like residential location, current mode choice, and other information volunteered during the sign-up process. This method of outreach makes it easier for university transportation programs to distribute information tailored to individuals who are most likely to find it

beneficial, rather than notifying the whole campus community with announcements that may or may not have relevance for individual members.

UCLA has employed GIS technology to geocode all of the residential locations of its community members. Understanding their trip origins gives the transportation program useful information about what kinds of transportation choices might be available and well-suited to them. For instance, someone who lives within two miles of campus might be provided with information about the benefits and incentives for bicycling or walking to work. Similarly, someone who lives five to ten miles away but near a transit stop may be given information about ridesharing, or transit options and subsidies. Someone who lives more than 30 miles away could be provided information about the university ridematching system and any existing vanpools they might be able to join. Identifying the origins of commuter trips using GIS and analyzing them in the context of other factors, such as the locations of recurring traffic congestion, can also help universities analyze which commuters might be most receptive to alternatives and target efforts to them.

Potential applications of social marketing and geographic targeting in other contexts

Social marketing and geographic targeting of transportation options has expanded the reach of mobility management programs at universities. These applications are possible in-part because universities are defined communities that people have elected to join as faculty, staff, or students. Many value their university affiliations throughout their lives, proudly displaying decals and logos, and attaching special significance to everyone and anything associated with their alma mater. By bringing all types of commuters together into a single, branded program through the use of social media and incentives, MPOs, TMOs, BIDs, and other agencies may be able to earn a similar level of access to information about commuters that universities have.

Applying these techniques in other contexts is likely to be more challenging. Certainly, privacy concerns and incomplete access to information about commuters would make it more difficult for an MPO, TMO, or BID to create a commuter club that reached all or nearly all of the commuters in their service areas. However, these organizations might seek to develop regional or district-level commuter clubs that are voluntary and which award benefits to members. Some MPOs and TMOs already employ strategies like this in their regional TDM and nonmotorized transportation programs. [16]

Transportation agencies could also explore geographic targeting strategies by working through employers. Such a program might utilize data provided by employers to provide tailored information to commuters about what transportation options are likely to be most relevant to them, upcoming service changes, or construction alerts. In the absence of this data, MPOs and partners might consider focusing outreach efforts on residents of the areas of the region most affected by congestion, or where specific transportation alternatives exist (e.g., near the park and ride lot, close to the regional bikeway).

The commuter club strategy is not a technology in itself, but it is supported by advances in social media, smartphones, and related technologies. Universities now have unprecedented access to commuter club

[16]See the FHWA Office of Planning report: Developing a Regional Approach to Transportation Demand Management for examples and more information.

members because of these technologies, allowing them to save resources on dissemination of information and applying them to more productive uses. Building an organization like a commuter club at a regional or municipal scale could potentially lay the foundation of a customer base for emerging information technology applications that provide real-time information about different transportation options including ride matching, transit, taxi services, and so on.

MPOs and State DOTs may also benefit from partnerships with universities and other large employers, TMOs, BIDs, DDAs, and other organizations that collect and analyze transportation data. Such partnerships could help regional planners to better understand the geographic sources of congestion and connect university mobility management programs with regional and statewide resources.

An example of the potential for this kind of approach is provided by a 2012 MIT/UC Berkeley study that found that the majority of congestion experienced by all regional commuters in the Boston and San Francisco Bay Area metropolitan areas resulted from commuters living in a handful of locations (Figure 1). Drivers who live in these locations need to use regionally-critical links (i.e., bottlenecks) as part of the majority of their trips. This study identified an opportunity to address congestion through a targeted approach, where transportation agencies, employers, or other organizations could provide incentives to change driver behavior as opposed to building expensive highway and transit capacity expansion. The MIT/UC Berkeley study estimated that if car commuters from the most problematic origins were reduced by 15 percent (representing a tiny fraction of all regional commuters), average travel times for all commuters in the region would improve by 18 percent. It is plausible that geographic and network analysis of this type led by States and MPOs, combined with a targeted social marketing and incentives programs led by universities, other large employers, local governments, TMOs or others could help achieve small, but targeted changes in driving behavior that would result in large regional benefits. This is one example of how MPOs and partners might find ways to apply innovations like those used by university campuses to a metropolitan scale.

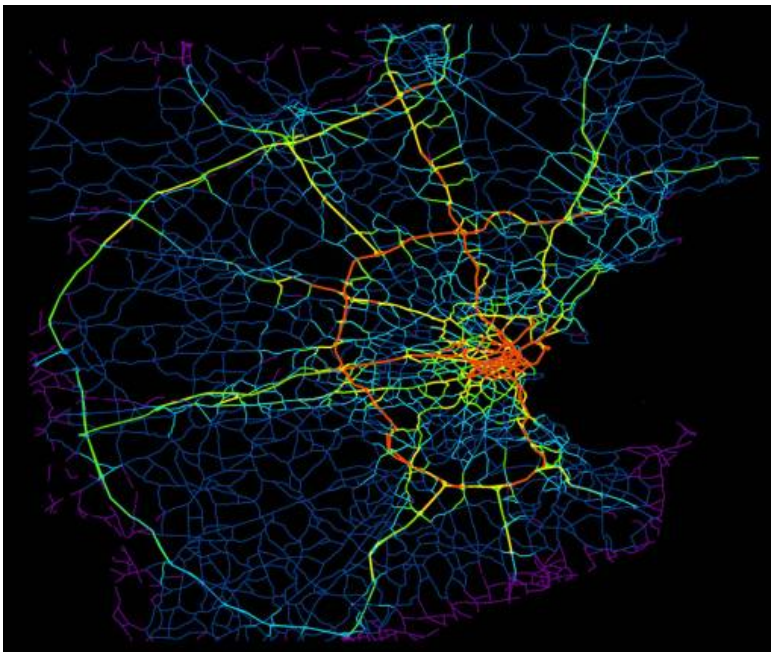

Figure 1: Map of the Boston Metropolitan Area, showing which road segments are used by the highest number of neighborhoods
SOURCE: MIT

Transit Agency Partnerships

Many universities demonstrate active engagement with the regional transit agencies that serve their communities. These partnerships have improved the level of transit service that they receive and help universities to have more influence over transit operations decision-making. For many campuses, transit mode share has increased significantly as a result of these efforts and coordination with other university programs such as active parking management ridesharing, and the development of nonmotorized transportation infrastructure.

Features of university-transit agency partnerships

All universities profiled in this report provide free or reduced fare transit passes to students and staff. Some, such as MIT, have provided free transit passes to carpoolers, vanpoolers, and SOV drivers to encourage them to use transit occasionally. Universities often make it easier for commuters to do so by employing technology that combines the transit pass with a parking permit or university ID card. For instance, at UW, the U-PASS transit pass is automatically integrated into every UW student's Husky Card, and because the card works on all of the Seattle metropolitan area's major transit systems, UW transit ridership has increased substantially, with a corresponding decrease in SOV travel.

Another way that universities have engaged in productive partnerships with transit agencies is by paying a portion of the cost of starting new pilot transit services. Stanford University found success with a recent program to pilot a peak-period bus service from the East Bay to campus. The bus has been so successful that AC Transit, which operates the service, is starting to use double decker buses to accommodate demand. Because Stanford is outside of AC Transit's service area, such a transit service would likely not exist without the partnership between the university and the transit agency. Prior to the partnership, Stanford operated a shuttle along this route, but the partnership with AC Transit is more efficient to operate and makes it easier for commuters to seamlessly integrate their commute with other transit trips.

A strong relationship with local and regional transit systems can also result in strategic influence for the university. For example, members of the UC Berkeley community are the largest single customer group using the AC Transit system. As a result UC Berkeley has some influence over transit service planning decisions, and is regularly engaged as a key stakeholder for AC Transit.

Transit Partnerships May Include:

- *Offering free or reduced fares for organization members*
- *Piloting new transit service to server organization members*
- *Working together and sharing data for enhance planning and operations*

Possible applications of expanded transit agency partnerships in other contexts

Metropolitan areas that have not yet developed a common transit fare card might look to UW's experience with the U-PASS as a model. Furthermore, transit agencies might look to UW's success and seek to develop partnerships with large employers (e.g., hospital systems, public school districts, government agencies) to integrate fare card technology and transit subsidies into employer or student

ID cards, incentivizing transit use and improving the availability of data regarding system use by various constituent groups. As the UW example has shown, there may also be opportunities to leverage the visibility and branding of transit fare cards as an umbrella to promote a broader package of services provided by the transportation organizations in the region (e.g., ridesharing, nonmotorized transportation). Large employers and business districts may also be able to influence the creation of new transit services like Stanford did with AC Transit, if they can contribute funding toward its operation and justify the service through analysis of employees' commuting habits.

Building on the university examples, BIDs, DDAs, or TMOs may be able to partner with regional transit providers, and MPOs may be well-suited as conveners of these partnerships. Enhancing two-way data sharing between transit agencies and employers, these organizations may be able to join forces to better equip all parties to make more informed decisions on proposed changes in the transportation programs and services. Furthermore, building stronger partnerships with transit agencies and sharing data about how community members use transit services may help demonstrate the value of certain routes or services which are deemed critical to members of the community, as was effective with UC Berkeley in their partnership with AC Transit.

Integrating Mobility Options into a Single Package

The primary lesson from each of the successful university programs examined in this report is that they offer many different mobility options in one package. A coordinated program of transportation alternatives, subsidies, and policies has the potential to affect long-term trends in driving behavior. The use of technology, such as smart cards, is making it easier for them to offer transit subsidies and other mobility benefits through a common platform. These developments have implications for the attractiveness of ridesharing, transit, and other modes, because commuters can more easily mix and match modes and services to suit their needs. Commuters who may be interested in non-SOV modes sometimes continue to drive alone because of the possibility of unexpected trips during or at the end of the work day that they could not easily make via transit alone. However, if they have easy access to car sharing vehicles, bike share, and casual carpooling, they may be open to leaving their car more often and commuting by other modes. In other words, integrating mobility options together makes the whole greater than the sum of its parts: each transportation option has its benefits, but together they become a new "mode," an integrated way of getting around which may be as flexible and attractive as a private vehicle.

Features of the coordinated approach to university transportation

Universities tend to be mode agnostic. They are not interested in influencing which specific mode of transportation commuters use, as much as providing options and managing congestion and demand for parking, which is expensive to provide. With parking and peak-hour trips being the primary challenge faced by university transportation agencies, the critical goal is mode shift and the most important performance measure is the reduction in SOV trips to campus. For this reason, universities are more aggressive in tailoring different alternative modes to different members of their communities rather than just supplying and marketing transit (although they do this as well). They seek to reduce SOV trips through a coordinated package of services and subsidies, as opposed to focusing on a particular mode

shift. UCLA, for example, has achieved similar SOV rates as transit-rich Downtown Los Angeles without a major high-capacity transit system serving it. It is able to do this through coordinated smart marketing of multiple transportation services within its community and active parking management.

Successful university programs offer a coordinated package of incentives and services to help commuters make the switch from driving alone. MIT has innovated in a particularly interesting way by providing monthly parking pass holders with a free public transportation pass for use on days when they do not need to drive. This system provides a relatively inexpensive incentive to the driver to occasionally use transit. The pilot program has more than 1,600 participants and has resulted in a four percent reduction in total annual vehicles parked on campus. MIT has recognized that people have complex needs when it comes to mobility. By taking a flexible coordinated approach, they can reach a wider swath of the population and convince them to sometimes try other modes of transportation.

A Coordinated Mobility Management Approach:

- *Has mode agnostic programs and incentives*
- *Offers complementary services*
- *Combines revenue generating activities like parking with provision of benefits to support alternatives to driving alone*

Possible applications of coordination in other contexts

MPOs, working with State and regional partners may consider pairing existing ridesharing and transit programs with enhanced financial incentives, such as the subsidies and progressive parking pricing structures that MIT, Stanford and UCLA have used. It may be that if applied at a downtown business district or sub-regional scale, similar SOV reductions could be seen, enabling these areas to require lower parking per square foot ratios and make more efficient use of land. The following possible applications are presented as food for thought, for how MPOs might advance these ideas working with partners within the metropolitan planning process.

Integrating ridesharing, TDM, and other strategies might be particularly interesting to explore in areas served by managed highway lanes (e.g., high-occupancy vehicle or toll lanes) which inherently provide incentives for ridesharing. In these places the total savings from both driving and parking to those who rideshare using managed lanes and receive parking subsidies could have a compounding effect. In such an arrangement, MPOs and partners could also explore innovative ways to cooperatively generate revenues for ridesharing and supportive programs (e.g., from higher parking and toll rates paid by SOV commuters).

Many areas of concentrated employment already have formal or informal organizations in place to help coordinate services of mutual interest (e.g., security, streetscape maintenance, graffiti removal) which may have potential to be used to enhance coordination on transportation subsidies and parking policies. However, because public organizations in business districts and employment centers typically do not have the level of control over pricing that universities do, implementation of such an approach would

likely require closer coordination between employers, private parking providers, and public agencies than typically exists. MPOs and regional councils of governments may be particularly well-suited to bring these diverse organizations together to better coordinate programs. Communities could also seek to build ridesharing and TDM partnerships to support livability and help revitalize older mixed-use districts[17] by providing a coordinated suite of mobility options, such as Yale has. These options include bike share, carsharing, and free shuttle buses, in addition to supporting transit service. Most of Yale's success at keeping SOV travel low is due to aggressive parking policies and options geared toward residents on campus and those who live proximate to campus. In this way, it has supported the revitalization of the downtown area because it has made living in and near downtown more attractive. Yale programs like subsidized carshare parking and membership, an innovative low-cost bike share system, and a free shuttle bus that takes residents and other affiliates of the university to other places of interest outside of the downtown area support a reduction in SOV travel while also making downtown living less expensive.

Even outside of the campus context, transportation agencies, cities, employers and others may be able to offer coordinated mobility options to help jump start residential demand, increase pedestrian activity, and increase the quality of life of car-free residents in urban centers. Cities and regions looking to support the growth of residential living and commercial activities in mixed use districts and neighborhoods might look to apply some of the comprehensive strategies employed by universities in order to improve transportation options for residents. In particular, Yale's experience with restricting parking, providing free shuttle service to important destinations, and supporting innovations like carsharing and bike sharing together make it easier for residents to live without cars. By reducing the demand for car ownership, less space needs to be occupied by infrastructure to support cars such as parking garages and wider streets, freeing up space for further economic growth and other civic uses.

As MPOs and State DOTs increasingly move toward a performance-based planning approach, with explicit linking of goals with associated performance metrics and targets, and monitoring of results, they may wish to consider a mode-agnostic approach to reducing unnecessary vehicle travel. Such an approach might adopt performance measures similar to those that universities use, like SOV trip reduction and the number of required parking spaces, to evaluate success. Mode agnostic performance measures may help communities focus on desired outcomes, as opposed to setting modal goals like increased transit ridership or number of carpools.

With their regional scale and explicitly multi-modal scope, MPOs can play an important role in establishing partnerships to pursue some of the integrated approaches highlighted in this research.

[17] See the FHWA Office of Planning report Moving Together in the 21st Century: How Ridesharing Supports Livable Communities for more detailed discussion of how ridesharing supports livability in existing communities.

Regional, State, and Local Policies and Partnerships

Regional and city policies to reduce trips to university campuses have been the impetus for engaging in many of the trip reduction practices of the most successful universities. Also, the engagement of universities with city transportation departments and other decision-making bodies has shown a lot of promise in improving transportation and livability in several cities.

Regional, State, and Local Policies and Partnerships:

- *Can spur employer action to manage commuter transportation*
- *Simultaneously support environmental, congestion management, and economic development goals*
- *Provide opportunities to improve visibility of campus community transportation needs*

Coordination between universities and their cities is essential to meeting both campus expansion needs and transportation management goals. Two of the examples profiled in this report show the importance of agreements between governments and universities in encouraging trip reduction while also accommodating new development. The State of Washington has a Commute Trip Reduction law[18] that applies to all major employers, requiring them to take steps to reduce single occupant vehicle trips. However, an agreement with the City of Seattle that predates that law led to the programs that UW has employed. The UW/Seattle agreement is more restrictive than the statewide law in the number of trips allowed by new development, and because UW is continuing to grow, it will be important for it to continue to maintain productive relationships with the University District and the broader City of Seattle.

Given UW's experience, local governments which are homes for or adjacent to large campuses (e.g., university, hospital, employer HQ) may look to the UW/Seattle agreement as a flexible model for how they can encourage campus managers to adopt similar programs. MPOs and States might also consider promoting such agreements as tools for transportation demand management at a regional or statewide scale.

Stanford University's recent impressive success at reducing trips can in many ways be traced to the General Use Permit that Santa Clara County issued with the university in 2000. This agreement allows the campus to develop new buildings on its land if it meets certain requirements, including mitigating expected traffic increases The University tracks the number of trips it generates as a result of this agreement and has been successful at keeping traffic constant. The much expanded TDM program along with the expansion of the campus shuttle are examples of the university's commitment to its goal, which has saved Stanford $100 million in available real estate, eased traffic problems, and helped to meet its air quality and sustainability goals according to Stanford Parking & Transportation Services staff.

[18] http://www.wsdot.wa.gov/transit/ctr

There are many areas in metropolitan regions throughout the United States that face development pressure and increasing property values in their most attractive areas. Like Stanford, these areas typically have high peak-period traffic congestion. These regions could consider the models that these university programs provide and explore policies like those of the County of Santa Clara to require development to be served by a travel demand management plan to limit new trips. Stanford's experience with the General Use Permit for development has shown that such a policy creates many winners and few losers. In Stanford's case, they are able to better manage congestion without building expensive new transportation infrastructure, and land previously dedicated to parking can be repurposed for much more productive uses. MPOs, with State and local partners, may be interested in exploring the potential to use a policy instrument such as the General Use Permit as a TDM tool on a broader regional scale.

Partnerships can go in the other direction too. Yale University has engaged with the City of New Haven on transportation planning and policy. Since Yale's population commutes by walking and bicycling to a greater extent than the general population, it brings a different perspective and expertise to the table when discussing road design and other aspects of transportation policy. Universities can follow Yale's lead in becoming an active participant in shaping transportation planning and policy within their communities because their needs are distinct from the larger population. Conversely, cities and MPOs might benefit from soliciting the participation of universities in transportation and land use planning activities.

Part III: Conclusion

The Potential for Ridesharing, Technology, and TDM to Support an Alternative Mobility Tipping Point

Technological developments are changing the ways that people travel and expanding and improving options for how universities and other organizations can influence commuting behavior. In the span of only a few years, smartphones and other technologies have dramatically altered the ability for travelers to access information and for organizations to improve the delivery of TDM programs. Many universities are on the cutting edge of these changes and provide a real-world laboratory for examining the potential of integrated approaches that combine new technologies and supportive policies to encourage ridesharing and multi-modal transportation alternatives. The notable successes of university transportation programs suggest that there are many valuable lessons to be learned which could potentially be applied at regional, local, or even statewide scales.

MPOs, State DOTs, transit agencies, local governments, and their partners operate under a different set of constraints than the universities featured in this report. They do not fully control parking supply or pricing, land use policy, or financial incentives – all of which are drivers of transportation behavior. However, these universities present models that combine ridesharing, TDM, transit, and other modes, enhanced with new technologies, to help push non-SOV modes past a tipping point where together they reinforce each other, become something greater and more attractive than they are individually. Adapting and applying similar models to a metropolitan, city, or statewide scale would undoubtedly be more difficult and complex than at the university campus scale. However, because of the great potential demonstrated by these universities, an investment in building regional partnerships along these lines may be worthwhile. In particular, MPOs may be uniquely positioned to champion these ideas and work to build regional or sub-regional coalitions to explore them.

Many universities have invested heavily in programs that encourage ridesharing and other transportation alternatives -- the resulting changes in commuter behavior have been dramatic and impressive. The institutions profiled in this report sometimes achieve SOV mode shares under 20 percent and exhibit dramatically lower SOV travel rates than their metropolitan areas as a whole. Most importantly, through investment and innovation in ridesharing and other TDM programs, many of them appear to have passed the theoretical tipping point, with non-SOV modes now representing the majority of trips to and from campus.

Some of the universities profiled here have achieved this only within the last fifteen years, after expanded investments in TDM programs. Many of the strategies featured in this research utilize emerging or recent technology innovations that make their programs more convenient, efficient, or comprehensive, and most pair them with supportive policies to improve their effectiveness.

Universities are experimenting with a variety of technologies, including ones which enable ad hoc casual carpooling, smartphone apps to improve rideshare and transit user experiences, new low-cost models of bike sharing using smart locks instead of docking stations, parking payment technologies that offer variable rates and provide rich data sources for planning and monitoring, transit fare card integration

through student and employee ID cards, and the use of social marketing and geographic targeting to improve the effectiveness of outreach activities.

The universities reviewed employ supporting policies like lifecycle cost accounting of parking spaces, trip reduction agreements with host cities or counties, tiered parking pricing, incentives for carpools and vanpools, and integrated mobility management programs that improve the convenience of all transportation options and services.

These universities have derived valuable benefits from these programs. The universities have been able to develop prime land that had previously been devoted to parking, enabling campus growth. They have also been able to avoid worsening traffic congestion and support university sustainability commitments while accommodating significant increases in their campus populations. These programs have helped the universities comply with local regulations and maintain good relationships with surrounding communities concerned about the potential traffic impacts of campus growth. Many of the universities profiled in this report have achieved these results through financially self-sustaining programs which generate revenue from parking, annual fees, or other sources, which they reinvest to support and improve their TDM programs.

Universities are in an enviable position to benefit from these technologies and policies because they largely control their environments and enjoy a great deal of access to information about their community members. State DOTs, MPOs, local governments, business districts, and other entities typically do not have similar discretion and access to data. However, these community transportation agencies could potentially learn from the models that these pioneering university transportation programs provide. Despite the challenges, if metropolitan areas were able to transfer some of the approaches that have so successfully been implemented by university campuses to a regional scale, they might accomplish similar results.

The potential for new technologies and policy innovations to improve the integration of ridesharing, TDM, transit, and other modes into a more attractive package is being demonstrated in university campus environments which can provide laboratories for larger communities. Through these innovations, we see that under ideal conditions it is indeed possible to pass the theoretical tipping point where these coordinated alternatives become equally or more attractive than driving alone. Although they will undoubtedly be more difficult to implement at a regional scale, the integrated university strategies presented here provide potential examples and food for thought, which MPOs and partners with SOV and congestion reduction goals may find useful. While significant barriers and unanswered questions remain about the potential to achieve these results outside of a campus environment; these techniques appear ripe for experimentation and application at district, city, or metropolitan scales.

Opportunities for Future Research

While this research into the use of technologies and policies that support ridesharing and TDM by universities provides valuable examples and demonstrates promising potential applications at other scales, many aspects in this fast-changing realm could benefit from additional investigation and more targeted research at a community or regional scale. The intersection of TDM and emerging technologies, and potential implications for metropolitan planning could be an important topic for policymakers, planners, and researchers to grapple with in the coming years. Below we outline a few promising areas of potential investigation:

- Are there examples of MPOs working with local communities, businesses, transit agencies, and other partners to develop integrated strategies similar to those that universities have implemented to reduce SOV travel? How do these partnerships develop and work together to implement strategies, develop supportive policies, and set goals and targets? How effective have they been, and what barriers remain to achieving greater success?

  What is the state of the practice and the state of the art in monitoring the performance of commute trip reduction programs? What technologies are becoming available that could assist transportation agencies in demonstrating the value of ridesharing and TDM programs in a performance-based planning and programming context?

- How are taxi-like ridesharing services which drivers use to generate income (e.g., Uber[19], Lyft[20], and Sidecar[21]) affecting more traditional ridesharing models that seek to connect peers who simply share costs? What kinds of impacts are they having on urban mobility, regional accessibility, car ownership, transit ridership, and taxi businesses? Can the providers of these services share aggregated data about their usage with cities and MPOs for the benefit of transportation planning?

- Can the growing ubiquity of mobile devices which track and transmit location information create new data sets for use in transportation planning, modeling, and operations management? Can the capacity for transportation agencies to apply these data be enhanced?

- How can States, MPOs, local governments, employers and commercial property owners best work together to leverage the power of active parking management to achieve trip reduction and economic development goals? Are there promising examples of partnerships among transportation agencies to lead efforts to coordinate supply, pricing, and integration of parking into air quality and traffic demand strategies?

[19] https://www.uber.com/
[20] https://www.lyft.com/
[21] http://www.side.cr/

- Will developments in smartphones and connected and autonomous vehicle technology increase the reliability and availability of ad hoc on-demand ridesharing services? Will it reduce the attractiveness of private vehicle ownership? How will these new technologies impact travel behavior at a regional scale?

- One potential reason why universities have been successful in implementing coordinated rideshare and TDM programs could be their orientation towards meeting the transportation needs of a specific local area and user community. They have done this in-part by taking a mode-agnostic approach, measuring their success in terms of the objectives of the trip destination (e.g., parking utilization, lifecycle transportation cost per building occupant) as opposed to traditional mobility measures (e.g., vehicle miles traveled, minutes of delay). Is there potential to include mode-agnostic, destination-oriented or accessibility-based performance measures in aspects of metropolitan and statewide transportation planning as well?

Part IV: Case Studies of Ridesharing and TDM in University Transportation Programs

The research for this report relied heavily on the investigation of university transportation programs in the U.S. completed in 2014. Based on a review of past research on the subject and on input from professionals in the field, the research team chose to examine six university transportation programs in detail.

The following university transportation programs were selected for in-depth study and are featured as case studies in the following section:

- **Massachusetts Institute of Technology**
- **Stanford University**
- **University of California, Berkeley**
- **University of California, Los Angeles**
- **University of Washington, Seattle**
- **Yale University**

These six institutions were selected to highlight programs that have demonstrated success incorporating new innovative aspects of ridesharing and TDM technologies and implementing policies that support them. The team held structured discussions with staff from each university transportation program and gathered information about the programs available on their websites. Table 4 summarizes both common and innovative elements of these programs.

These programs are not representative of all university ridesharing and TDM programs; there are certainly other universities that offer innovative programs not covered in this report. However, conducting a complete scan of all universities was outside the scope of this effort, and the research team believes these examples represent a compelling cross-section of university practices in this area.

Each of these universities offers lessons for other university peers as well as community organizations, MPOs, State DOTs and others working in the field of transportation and land use planning. Each case study begins with a description of the university, its community context, and the transportation issues it faces. It concludes with a discussion of its transportation programs and some key insights that it may have for other types of organizations or for university peers.

Table 4: Summary of Transportation Program Elements of Case Study Examples

Category	Program Element	MIT	Stanford	UC Berkeley	UCLA	UW	Yale
Ridesharing	Online ridematching services for carpools and vanpools	●	●	●	●	●	●
	Vanpool operation or membership subsidy	●			●	●	
Parking	Discounted or free parking for pre-arranged carpools and vanpools	●	●	●	●	●	●
	Discounted parking for ad-hoc carpools					●	
	Tiered parking permit structures based on location and time-of-day			●	●	●	
	Lifecycle cost accounting for parking spaces	●	●				
	Cash incentive for use of alternative modes		●				
	Free transit pass with purchase of full-time parking permit	●					
	Reduced prices for occasional parkers	●				●	●
Transit	Campus shuttle or circulator	●	●	●	●	●	●
	Free or discounted transit pass	●	●	●	●	●	●
	Fare card/ID integration	●	●	●	●	●	●
	Transit agency partnership for special service, rates, or data sharing	●	●	●			
Bike	On-campus bike share locations with subsidized membership	●				●	●
Other	On-campus carsharing vehicles with subsidized membership	●	●	●	●	●	●
	Personalized commute planning assistance		●	●		●	●
	commuter benefits "club"		●		●	●	
	Agreements with local government to limit vehicle traffic	●	●			●	

Massachusetts Institute of Technology (MIT)
Cambridge, Massachusetts

Description of the University

The Massachusetts Institute of Technology (MIT) is a private research university with over 22,000 students, faculty, and staff. The Institute is located on 168 acres in Cambridge, Massachusetts, within the heart of the Boston metropolitan area, one of the densest urban areas in the United States (Figure 2). Approximately 75 percent of the Institute's 4,500+ undergraduate students live on campus in MIT-provided housing or affiliated fraternities, sororities, and living groups. The remainder of undergraduates and approximately two-thirds of MIT's 6,800+ graduate students live in off campus housing in Cambridge, Boston, and surrounding cities and towns, as do most of the Institute's 11,000+ faculty and staff (Table 5). The campus is land-constrained on all sides by the Charles River and the adjacent Kendall Square and Central Square business districts.[22]

Figure 2: Aerial view of the MIT Campus with Charles River and Surrounding Areas of Cambridge and Boston
SOURCE: MIT 2030

Table 5: Characteristics of MIT and Boston Metropolitan Area Commuters

	Massachusetts Institute of Technology (MIT)	Boston, MA Metropolitan Area
Population:	22,000 (students/faculty/staff)	4,180,000
Percent of Students Living On-Campus:	50%	n/a
Neighborhood/Regional Context:	Urban	Large (1 million +)
Public Transportation Context:	Subway, Local Bus, Express Bus, Shuttle Bus	Subway, Light Rail, Commuter Rail, Intercity Passenger Rail, Local Bus, Express Bus, Ferry Boat
SOV Commute Share:	21%	70%
Carpool/Vanpool Commute Share:	7%	8%
Public Transportation Commute Share:	39%	14%
Walk/Bike/Other Commute Share:	33%	8%

SOURCES: MIT and U.S. Census Bureau; 2013 American Community Survey 5-Year Estimates (Table B08101)

[22] MIT Facts, 2015

Community/Regional Context

MIT is a key institution in one of the largest concentrations of higher education in the United States. The core of the Boston metropolitan area, roughly bounded by the Massachusetts Bay to the East and surrounded by I-95/MA-128, is home to more than 50 institutions of higher education, which in addition to MIT includes Harvard University, Boston University, Northeastern University, Tufts University, and numerous other nationally and internationally-renowned schools. Combined enrollment at colleges and universities in the Boston area is close to 250,000 students.[23]

The MIT campus is located adjacent to Cambridge's Kendall Square neighborhood, one of the densest concentrations of high-tech businesses in the region, and in the country. Kendall Square has recently seen a dramatic expansion of office and commercial space, with a more than 40 percent increase (4.6 million sq. ft.) since 2000. However, this expansion was accommodated without adding new vehicle trips to Kendall Square roads. In fact, vehicle trips decreased slightly during this period of expansion.[24] This achievement is due in large part to the efforts of the City of Cambridge, MIT, and other large employers in the area, who have structured their transportation benefits and programs to encourage alternatives to SOV travel. These efforts have also been supported by the walkable campus design and proximity to high-capacity public transportation (Figure 3).

Figure 3: Map of MIT Campus in 2013, with Building Types and Walking Distance Radii
SOURCE: MIT 2030

The Massachusetts Bay Transportation Authority (MBTA) provides subway, express bus, and local bus service to the MIT campus and throughout the Boston metropolitan area. Most notably, many visitors to campus arrive via the Kendall/MIT stop on the MBTA's Red Line subway (its busiest line), which connects

[23] U.S. Department of Education, Digest of Education Statistics, 2012, Chapter 3
[24] *Car-free commuting push pays off in Kendall Square*, Boston Globe, July 25, 2012

to additional MBTA subway lines and to Boston's South Station (MBTA/Amtrak), one of three commuter and intercity passenger rail stations serving the city.[25] MIT provides a popular on-campus shuttle and is also served by the EZ-Ride shuttle provided by the Charles River Transportation Management Association (TMA), which connects travelers to Boston's North Station (MBTA/Amtrak), and by the MASCO M2 shuttle, which moves travelers between Boston's Longwood Medical Area, MIT, and nearby Harvard Square in Cambridge.

Cambridge and the neighboring cities of Boston and Somerville are among the cities with the highest population density in the United States. Due in large part to their dense development patterns and pre-automobile age historic street patterns, commuting by car is less common here than in many areas of the country. However, the greater Boston metropolitan area is very large, spanning much of the eastern third of Massachusetts and home to more than 4.1 million people. The Boston metropolitan area includes many low-density, suburban cities and towns that are very much auto-oriented, although many are also served by regional commuter trains and buses. MIT is a regional employer with a commute shed that extends beyond the Boston metropolitan area into neighboring areas of Rhode Island, New Hampshire, and Vermont, as well as Central Massachusetts.

University Transportation Issues and Trends

Due in large part to changes in parking policies and incentive programs, MIT has been successful in shifting the travel patterns of campus users. During the 10-year period from 2002-2012, MIT experienced a significant shift from single-occupant vehicle (SOV) auto commuting to ridesharing, transit, and nonmotorized transportation modes. During this period the SOV mode decreased by 20 percent while carpooling and vanpooling increased by 14 percent, transit use increased by 15 percent and bicycling increased by 13 percent (Figure 4). Walking reduced by 42 percent during this period, but MIT transportation staff believes the majority of walkers shifted to bicycling or transit, perhaps because recent rising housing costs in Cambridge have resulted in students living further away from campus.

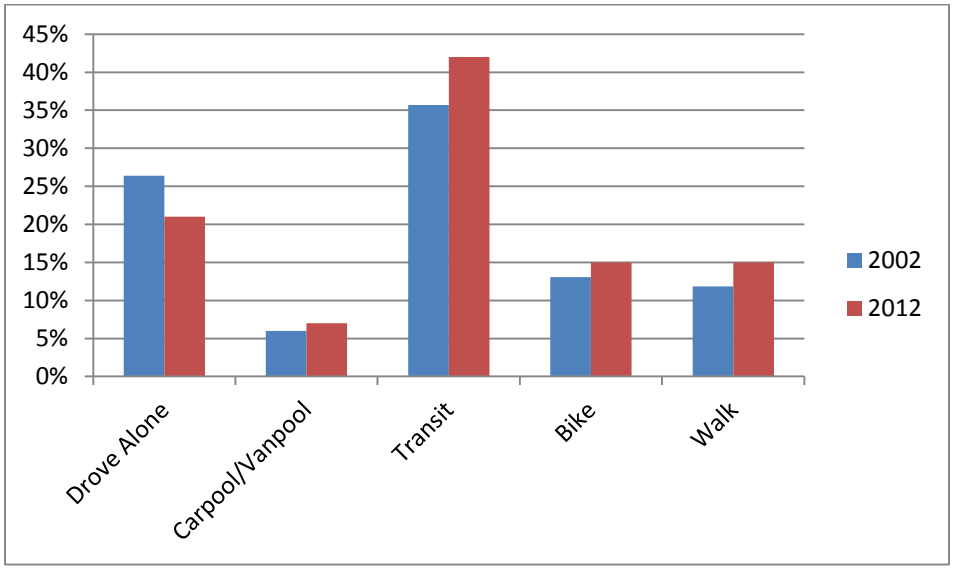

Figure 4: Change in MIT Commute Mode Split 2002-2012

[25] MBTA Ridership and Service Statistics, 2014

SOURCE: MIT Parking and Transportation

Those who do drive are now more likely to be occasional drivers, using ridesharing and transit modes at least 1 day per week. The shift from SOV to other modes resulted in an overall reduction in those who drive to campus of 5 percent, despite increases in campus population and new buildings. It enabled the Institute to remove 810 parking spaces.

MIT commute patterns differ dramatically from the region as a whole. The Boston metropolitan area has a lower than average SOV commute share at 70 percent. However, MIT commuters drive alone only 21 percent of the time (Figure 5). Transit, walking, and biking are similarly much more prevalent for MIT commuters than for the region as a whole, and, interestingly, carpooling and vanpooling are slightly less common for MIT commuters than others in the region. These differences may be due to the high transit accessibility of the campus and relatively higher population density of the surrounding neighborhoods than of the region as a whole.

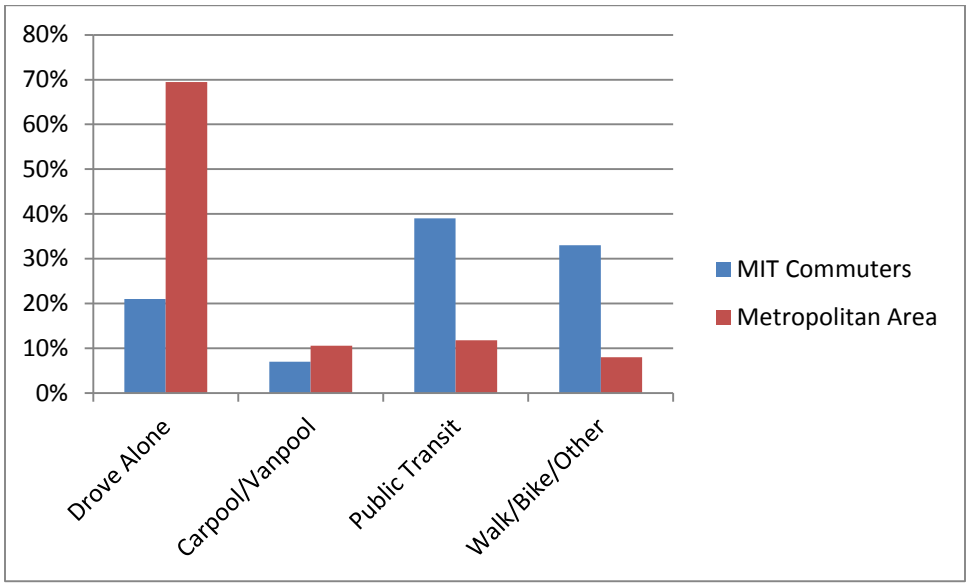

Figure 5: Comparison of MIT Commute Mode Split to Boston Metropolitan Area, 2014
SOURCES: MIT Parking and Transportation and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

MIT's Current Transportation Programs

Over many years MIT has developed a coordinated and extensive package of transportation programs to support campus transportation needs. The construction of new buildings and resulting loss of surface parking spaces, an institutional commitment to accounting for the full lifecycle costs of all facilities, and negotiations with the City of Cambridge regarding parking and transportation policies have all been factors in the expansion of these programs. New construction plans which will eliminate a further 800 parking spaces, and an agreement with the

MIT commuter connections

Figure 6: MIT Commuter Connections Logo
SOURCE: MIT Department of Facilities

City of Cambridge to accommodate all campus traffic at MIT parking facilities, have helped drive a focus on reducing vehicle trips to campus through a dynamic mix of alternatives. MIT Commuter Connections (Figure 6) provides a package of ridesharing services, incentives, and supporting programs that are mutually-reinforcing and enable very low rates of SOV travel. Together, these services support rideshare users by pairing financial incentives with back-up transit, non-motorized transportation, and taxi services which enhance the reliability of alternative transportation options. These services support not only rideshare users, but users of all non-SOV transportation modes.

Examples of the transportation services MIT provides include:

- A 50 percent carpooling and vanpooling parking subsidy (60 percent increase since 2002) and a free MBTA pass for all ridesharing users.
- A $100 per month per rider subsidy for vanpools in addition to free parking.
- Ridematching services through Zimride [26] and NuRide[27] open to both students and staff, with 435 registered carpool members and 65 vanpool riders.
- Progressive parking permitting policies with high prices for full-time parkers and discounts for occasional parkers. Full time parking permits come with the option of a free MBTA pass.
- A popular campus shuttle with nearly 1 million annual riders (up 100 percent from 2002) and participation in the EZ-Ride shuttle[28] to link travelers to north-bound commuter rail lines.
- A 50 percent public transit subsidy for students and staff, with automatic fare card integration into student ID cards. A subsidy is also offered for use of private regional bus operators.
- Extensive facilities for bicycle commuters, including 3,000+ bicycle parking spaces, secure cages, indoor bike rooms, and repair stations (Bicycle Friendly University silver designation from the League of American Bicyclists).
- Discounted Hubway bike share[29] memberships (a 75 percent discount) with over 1,700 active users.
- Emergency ride home service.[30]
- Zipcar membership discounts, with 20+ vehicles on-campus and more than 6,000 registered users.[31]

[26] https://www.zimride.com/
[27] http://www.nuride.com/
[28] http://www.charlesrivertma.org/ezride-shuttle/
[29] http://www.thehubway.com/
[30] http://web.mit.edu/facilities/transportation/emergencyride.html
[31] http://www.zipcar.com/

Innovative Policies and Technologies

MIT's approach to reducing vehicle trips is mode-agnostic and analytical, with an emphasis on using pricing to match benefits with costs, and technology to make alternatives more convenient and accessible. The overarching goal is to reduce the amount of land dedicated to parking by providing attractive alternatives to driving alone.

The Institute accounts for the estimated full lifecycle costs of building and maintaining parking spaces ($100,000/space and $3,000/year) when making campus planning decisions. As such, MIT has gradually increased the cost of full-time parking permits to reflect the high cost of providing parking and introduced new policies and programs to incentivize alternatives. Those who wish to drive to campus may now opt to purchase an occasional parking permit, which allows them to pay a daily rate to park when they need to drive, but take alternative modes on other days. Approximately 50 percent of MITs parking pass holders now use the occasional parking pass, and they park on average only 5 days per month. Occasional parking pass holders can take advantage of subsidized transit fares on days they don't drive. This system provides clear financial incentives to occasional drivers with both a daily fee to park and a subsidized transit benefit when they do not.

For employees with full-time parking permits MIT started a new pilot program where the Institute provides a free public transportation pass for use on days when they do not need to drive. MIT's relationship with the MBTA allows the Institute to only pay for actual rides taken under this pilot program, making the program affordable. And because of MIT's lifecycle accounting method for parking, it is easy to see that even a small reduction in parking needs resulting from occasional transit use by regular drivers would result in significant long-term savings for MIT. The pilot program has more than 1,600 participants and has resulted in a 4 percent reduction in total annual vehicles parked on campus.

Many of MITs innovations are centered around helping users experience the full cost of their transportation choices on an incremental basis. By providing carpoolers and vanpoolers with reduced parking rates and a free transit pass, MIT is helping correct for a hidden subsidy that the Institute has provided by building and maintaining parking spaces (Figure 7). Similarly, by continuing to raise the price of full-time parking permits, these users are required to take on more of the actual cost of providing parking. MIT is currently working toward a shift away from parking permits to a daily rate parking structure which will make these costs more transparent to all drivers.

MIT also works to leverage new technologies to make its transportation system work more efficiently and to provide supportive services for rideshare and alternative transportation users. The Institute's partnership with the MBTA to integrate the CharlieCard fare card into the MIT ID card ensures that all campus users always have their transit pass. It removes the effort of remembering two cards and simplifies the process for receiving transit subsidies from MIT. This partnership also provides the Institute with data from the MBTA about MIT transit users, which help the parking and transportation staff better understand the needs and habits of its community, establishing a robust quantitative foundation upon which to base future transportation services decisions.

Figure 7: Map of the MIT campus and surrounding areas showing on-campus parking lot locations
SOURCE: MIT Campus Map

MIT's long-standing relationship with Zipcar, a company co-founded by an MIT graduate, provides convenient options for campus residents and staff to rent a car for short periods of time when they need one and has become a well-established option, particularly for short trips and for students living on campus. Going forward, the Institute plans to develop an e-parking system that will allow drivers to use computers and smartphones to book a parking spot in advance and to see in which lots spaces are available. This innovation will provide better information to drivers before they leave home, informing their mode choice and potentially reducing campus traffic congestion caused by unfruitful searching for parking spaces. However, in addition to benefiting drivers, the use of an application to book parking spots will provide an opportunity for enhanced data collection about the behavior of drivers: rideshare users, SOV drivers, and those who mix and match among multiple options.

In addition to subsidizing traditional public transportation options, MIT subsidizes use of private regional bus services and provides local transit services through its own campus shuttle and through the EZ-Ride and M2 shuttles, all of which MIT affiliates may use free of charge. These systems provide important supplementary transit services which complement and fill gaps in the MBTA schedules. Ridership has seen dramatic growth over the past decade, supporting carpoolers and vanpoolers who may work on opposite ends of campus from each other, commuter rail users who need an easy connection from campus to the train station and easy connections across campus for all users.

As with many campus communities, MIT provides Zimride and NuRide ridematching services to help potential carpoolers connect. The services are well-used with over 3,000 active users. Information is not available to MIT about the number of carpools that have actually formed using the service. However, MIT staff noted that participation increased notably following the introduction of the free public transportation pass for registered carpoolers. MIT staff noted a desire for better data from the

ridematching service, and that enhanced reporting from the service could help them better evaluate the effectiveness of ridesharing-supportive technologies and polices on the formation and activity of carpools and vanpools.

Key Insights for Peers and Communities

The MIT Commuter Connections program provides several key insights for States, MPOs, local governments, and BIDs seeking to encourage and support ridesharing and supportive services which reduce SOV travel:

- **Full lifecycle cost accounting and use of pricing and subsidies** helps shift driving behavior to better reflect long-term costs of providing parking.
- **Providing free transit pass** to carpoolers, vanpoolers, and full-time SOV drivers can further draw down driving rates.
- **Using new technology to make ridesharing and subsidies easier to use** improves adoption and supports SOV reduction.
- **A coordinated program of transportation alternatives, subsidies, and policies** has the potential to affect long-term trends in driving behavior, specifically to reach targeted SOV trip reductions.

MIT's analytical approach to SOV reduction is goal-oriented, centered on an overall need to reduce the amount of land dedicated to parking and to fully account for parking costs. It is mode-agnostic, seeking to reduce SOV trips through a coordinated package of services and subsides, as opposed to focusing on a particular mode shift. The rideshare, transit, and nonmotorized transportation options provided by the Institute have enabled it to complete critical building expansion and construction projects in a highly-constrained, high land-value environment, allowing it to grow without acquiring new land and also helping maintain a critical relationship with the City of Cambridge. A key component of MIT's approach is its commitment to using a full lifecycle cost analysis for all parking spaces, which helps it give greater weight to long-term policy outcomes. MIT's use of pricing and incentives throughout its transportation programs is innovative, and although it may be challenging to establish, is transferable to a metropolitan context.

Many downtown business districts and employment centers in the United States struggle with providing enough parking to meet the needs of the businesses located there, while still making efficient use of land. Where land values are particularly high there may not be enough available parking at reasonable rates, stifling new development and driving up demand for major high-capacity transit investments. Conversely, where land values are lower than average, there may be a perverse incentive to over-build parking to a level that could accommodate peak demand for SOV travel during major events, leaving much of the core inactive and empty during off-peak periods.

States, MPOs, cities, and BIDs may consider pairing existing ridesharing and transit programs with enhanced financial incentives, such as the subsidies and progressive pricing structures that MIT has used to achieve a very low SOV rate. For example, an MPO or BID might work with city parking departments

and large employers to develop a common methodology for determining the full lifecycle cost of providing parking spaces in the area. Then, it might work with these stakeholders to help parking owners adjust the prices charged for parking in a coordinated manner, such that every-day SOV travelers pay the highest rate, while rideshare participants and occasional drivers pay a lower rate, and receive transit subsidies and other benefits. This strategy is likely to be most effective when coupled with multiple affordable transportation options which can be used as back-up for days when rideshare arrangements do not work out (e.g., transit, bike sharing, carsharing, and emergency ride home taxi).

It may be that if applied at a downtown business district or sub-regional scale, similar SOV reductions could be seen, enabling these areas to achieve lower parking per square foot ratios and make more efficient use of land. Such a strategy might be particularly effective for areas that are served by managed highway lanes (e.g., high-occupancy vehicle or toll lanes) which provide incentives for ridesharing. Furthermore, as has been theorized by renowned parking expert Donald Shoup[32], re-evaluation of the rates charged for public parking spaces based on market demand may also have significant effects on the behavior of drivers, thereby reducing congestion as well. Revenues derived from higher parking and toll rates paid by SOV commuters might be used to support coordinated administration and marketing efforts for ridesharing and supportive programs.

Many areas of concentrated employment already have formal or informal organizations in place to help coordinate services of mutual interest (e.g., security, streetscape maintenance, and graffiti removal) which could be used to enhance coordination on transportation subsidies and parking policies. However, because public organizations in business districts and employment centers typically do not have the level of control over pricing that an institution like MIT does, implementation of such an approach would likely require closer coordination between employers, private parking providers, and public agencies than typically exists.

Nonetheless, MIT's program provides an example of what is possible when transportation options, subsidies, pricing, and policies are well-coordinated with a goal-oriented approach to reducing SOV travel. No one strategy employed by MIT is a "silver bullet," but together the package enhances ridesharing, non-motorized transportation, and transit together, with each one supporting the others. Furthermore, MIT's use of emerging technologies to better link these services together reinforces their reliability and convenience. MPOs, DOTs, and local governments might look to this example as a demonstration of the potential for a coordinated approach at a metropolitan, statewide, or city scale, acknowledging that there are structural limitations that would be difficult to overcome. However, by seeing the potential for long-term shifts in travel behavior through the eyes of MIT's success, transportation agencies might find impetus to engage in the difficult partnership-building and coordination which would be needed for success in a metropolitan, State, or city context.

For More Information

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[32] http://shoup.bol.ucla.edu/

Stanford University
Palo Alto, California

Description of the University

Stanford University is a private research university with a daily population of close to 32,000 people including 7,000 undergraduate students and 9,000 graduate students (Table 6). The main campus (Figure 8) is large with 8,180 contiguous acres mostly adjacent to the suburban San Francisco Peninsula community of Palo Alto in unincorporated Santa Clara County. The university owns some other property in nearby Redwood City which is planned to be developed in 2016 and has a few other properties in the area but the overwhelming majority of university activity takes place on the main campus. Almost all undergraduate students live on campus as do most graduate students, but many postdoctoral candidates, medical residents, staff, and faculty live in communities beyond Palo Alto. The majority of staff and faculty live within a 20-mile commute shed from Palo Alto. But due to the rising costs of housing in the area, a growing number of employees are living further and further away from campus in the East Bay, south Santa Clara County and even the Central Valley.

Figure 8: Stanford University Campus
SOURCE: Stanford University

Table 6: Characteristics of Stanford and San Francisco Bay Area Commuters

	Stanford University	San Francisco – San Jose, CA Combined Metropolitan Area
Population:	32,000 (students/faculty/staff)	8,470,000
Percent of Students Living On-Campus:	75%	n/a
Neighborhood/Regional Context:	Suburban	Large (1 million +)
Public Transportation Context:	Commuter Rail, Local Bus, Express Bus, Campus Shuttle	Heavy Rail, Light Rail, Commuter Rail, Intercity Passenger Rail, Local Bus, Express Bus, Intercity Bus, Ferry Boat
SOV Commute Share:	49%	72%
Carpool/Vanpool Commute Share:	9%	11%
Public Transportation Commute Share:	26%	10%
Walk/Bike/Other Commute Share:	16%	7%

SOURCES: Stanford and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

Community/Regional Context

Stanford University is one of the primary incubators of Silicon Valley. Its northeastern border is El Camino Real, a wide suburban highway, and the campus lies between the I-280 and U.S. Highway 101 corridors, which are the two primary highway routes between the San Francisco and San Jose major urban centers. Caltrain, a commuter rail system serving the San Jose – San Francisco corridor, has a stop just north of the campus. In addition to Caltrain, the campus is accessible by bus service provided by San Mateo County Transit (SamTrans) and the Santa Clara Valley Transportation Authority (VTA). The university has also contracted with Alameda-Contra Costa County Transit District (AC Transit) to provide commuter service from the East Bay.

The urban geography of the immediate surroundings in Palo Alto can be characterized as a mid-twentieth century suburban community dominated by single-family homes, though the area has seen more pressure for higher density housing in recent years. Due to its proximity to Stanford and centrality within the Silicon Valley business community, Palo Alto is one of the most expensive real estate markets in the United States. The transportation and land use pattern in the area is primarily oriented towards automobile travel.

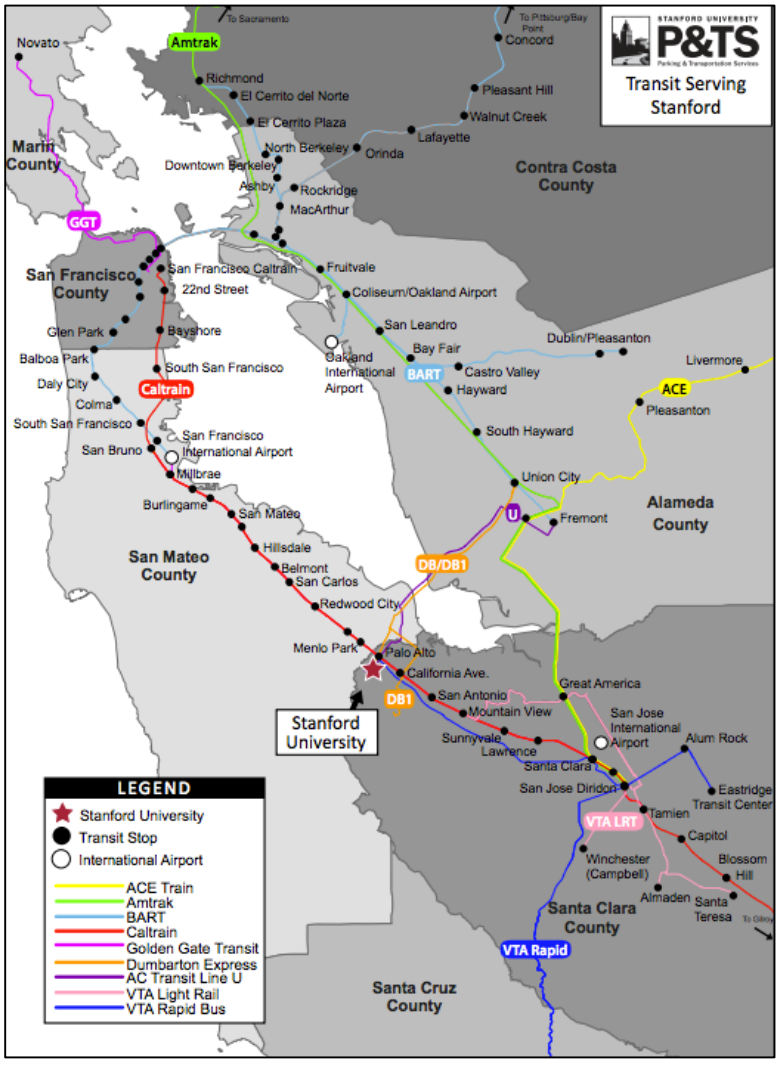

Figure 9: Bay Area Transit Serving Stanford University
SOURCE: Stanford University Parking & Transportation Services

University Transportation Issues and Trends

As recently as 2001, the vast majority of employees at Stanford drove alone to campus. Today, fewer than half of all employees drive alone. Instead, Stanford's community has embraced other ways of commuting to campus with bicycling and Caltrain ridership registering the biggest increases in travel (Table 7, Figure 10, and Figure 11).

Table 7: Stanford University Employee Commute Mode Split 2003-2014

University Employee Mode Splits 2003 – 2014 (Percent)								
	Drive Alone	Caltrain	Shuttle/ Bus	*Transit*	Carpool	Vanpool	Bicycle/ Other	Walk
2003	**72.1**	8.3	2.2	*10.5*	8.6	0.4	7.2	1.2
2004	**73.4**	8.2	2.0	*10.2*	8.4	0.3	6.8	1.0
2005	**68.9**	10.7	2.9	*13.6*	9.0	0.4	7.1	1.1
2006	**61.0**	13.0	4.0	*17.0*	10.8	0.4	9.2	1.7
2007	**57.6**	14.3	4.0	*18.3*	9.9	0.2	11.3	2.7
2008	**57.7**	17.0	4.2	*21.2*	10.0	0.3	9.4	1.5
2009	**52.9**	17.1	4.8	*21.9*	10.3	0.3	12.1	2.5
2010	**54.2**	15.6	4.9	*20.5*	10.9	0.3	11.8	2.4
2011	**51.6**	17.2	6.3	*19.5*	10.5	0.2	11.8	2.4
2012	**52.4**	17.8	5.9	*23.7*	9.8	0.2	11.5	2.4
2013	**48.7**	19.5	6.3	*25.8*	9.3	0.3	13.3	2.8
2014	**49.4**	19.4	6.3	*25.7*	8.2	0.3	13.8	2.7

SOURCE: Stanford University Parking & Transportation Services

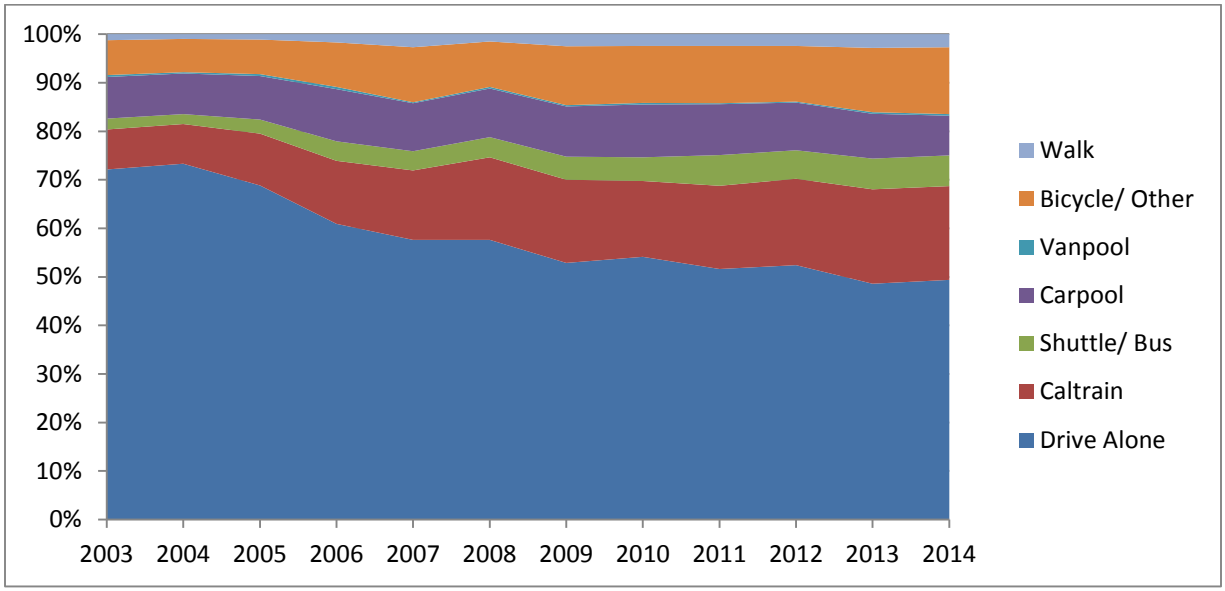

Figure 10: Stanford community mode split. 2003 -2014

SOURCE: Stanford University Parking & Transportation Services

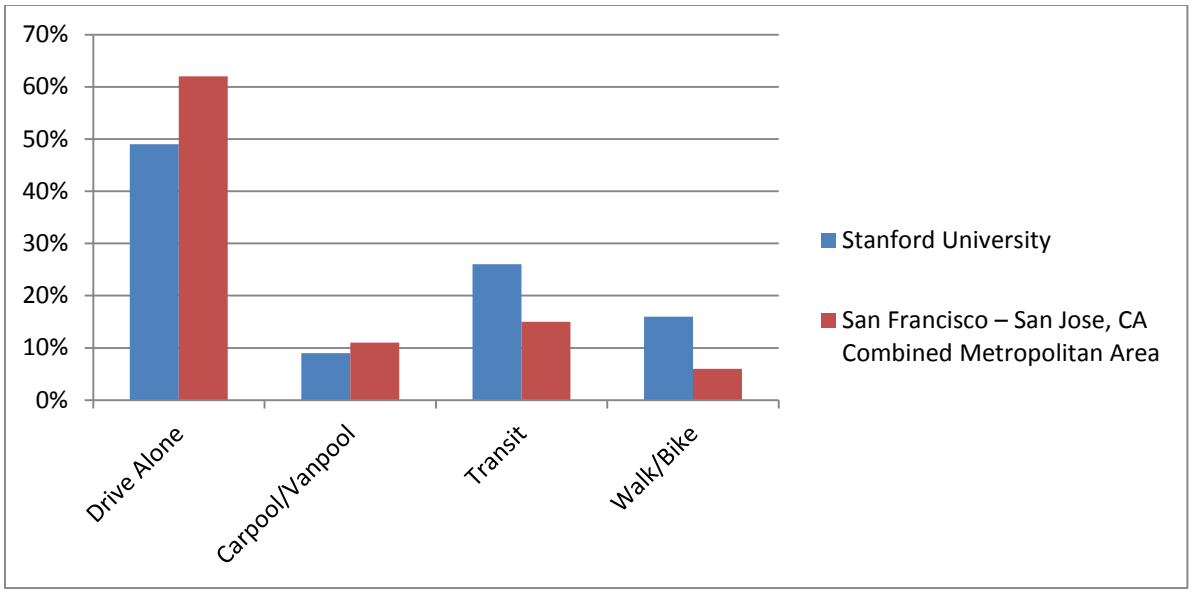

Figure 11: 2014 Commute Split for Stanford University and San Francisco Bay Area
SOURCES: Stanford and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

Stanford's mode split compared to the San Francisco Bay Area indicates that Stanford has a lower drive-alone rate than the wider region. Stanford commuters choose instead to bicycle and take transit by a much greater degree than the population of the region as a whole. The same percentages of Stanford commuters carpool/vanpool as Bay Area commuters. Perhaps reflective of the suburban nature of the community, Stanford commuters walk less than the regional average

Stanford's Current Transportation Programs

The impetus for the reduction in driving at Stanford despite the growth of the university's daily population appears to be Stanford's entrance into an agreement with the County of Santa Clara for a General Use Permit (GUP) in 2000. This agreement allows the campus to develop new buildings on its land if it meets certain requirements, including mitigating expected traffic increases. As a result of the GUP, Stanford has committed to a goal of no net new peak commute trips over the duration of the GUP and has dedicated significant resources towards facilitating alternatives to driving alone.

Stanford has the typical array of university transportation programs but it has packaged them in a way that has allowed it to achieve driving reductions that stand out compared to its peers. Stanford's alternative transportation program includes:

- "Marguerite," an extensive and free shuttle bus system that covers all parts of campus, and includes selected off-campus shopping, dining and entertainment destinations, and regular frequent service to the transit center in Palo Alto. Marguerite also provides service to nearby Stanford residences and the Line U East Bay Express service.
- Free transit passes for Caltrain (commuter rail) and VTA bus, light rail, and express bus service for eligible affiliates.[33]

[33] http://transportation.stanford.edu/GoEcoPass

- Free rides on the Line U East Bay Express[34] (bus service contracted with AC Transit).
- Parking permit fees that help fund some TDM programs. The lowest-cost annual parking permit is $330 and parking revenue pays for the shuttle bus service and the Commute Club Clean Air Cash incentive program.
- The Commute Club program, which offers incentives that include up to $300 per year in Clean Air Cash or Carpool Credit to forego the purchase of a regular monthly or annual parking permit.
- Emergency ride home program.
- Bicycle program, which includes bike registration, bike safety education, bike safety stations throughout campus, and bike helmet and other promotions.
- Pre-tax purchases of transit passes and parking.
- Ridematching service, provided by vRide.[35]
- Free commute planning assistance.
- Hourly/daily car rental and car sharing (Enterprise Rent-A-Car branch[36] on campus and Zipcar at Stanford[37]).Promotions and campaigns to encourage alternative commuting as well as off-peak trips to and from campus.

Innovative Policies and Technologies

The cornerstone of Stanford's transportation marketing program is the Commute Club. The idea behind the Commute Club is to create a collective identity among alternative transportation commuters with rewards tied to membership. Membership in the Commute Club has grown to over 9,000 (32 percent of commuters). Members do not purchase a monthly or long-term parking permit, except a carpool or vanpool parking permit. Commute Club members are allowed to buy up to eight daily parking passes per month in order to allow some flexibility among members. As members of the Commute Club, participants are eligible for up to $300 per year in Clean Air Cash or Carpool Credit and can participate in membership-based promotions.

Stanford has increased its Clean Air Cash incentive payments since the program started in 1995 so it is now roughly equal to the lowest-cost long-term commuter parking permit. In effect, commuters who opt out of a monthly parking permit enjoy a $648 monthly value, when considering the $300 incentive payment coupled with the $300-plus savings from avoiding the parking fees.

The Clean Air Cash program is paid for through parking funding. Some of the other programs like the Marguerite shuttle system are also funded by parking funds. Parking fund sources include revenue from the sale of parking permits as well as savings from the mitigation requirements of the General Use Permit that the university internalizes in its budgeting process. When it constructs a new building, Stanford applies a one-time "fee," or set-aside, per square foot of new building space toward mitigation funds. If it weren't for the mitigation program, Stanford would have to spend that money on

[34] http://actransit.org
[35] https://ride.com/stanford
[36] http://transportation.stanford.edu/enterprise
[37] http://www.zipcar.com/stanford

constructing additional parking and maintaining those parking spaces. Stanford's use of innovative budgeting in this way allows it to provide a more robust alternative transportation program.

Stanford already experimented with using RFID to monitor incoming and outgoing traffic on campus. The university partnered with Stanford professor Balaji Pravhakar who, with USDOT funding, created a commuting game aimed at changing travel behavior. Participants in the game received a RFID device that would detect when they would enter and exit campus and they received rewards when they commuted outside of the morning and evening peak times.

Carpool and vanpool participation has not grown since 2000 but the program continues to look for ways to increase it. Like many campus programs, Stanford uses Zimride for ridematching but has had a difficult time tracking how well it is working since the only metric Zimride can provide is how many people have registered and not how many carpools have actually formed. In 2014, Stanford began offering Ride as a commute ridematching service, which features a technology platform that not only finds matches but also manages payments between carpool and vanpool members. The Ride program also includes "guaranteed rides." Ride maintains a fleet of on-campus vehicles for Stanford participants using Ride. This program supplements Stanford's existing emergency ride home program, which offers taxi or rental car options for any eligible Stanford commuter who uses alternative transportation for their commute on a day they need an emergency ride home.

Stanford has innovated in many of its program areas. Stanford has an active role in coordinating to provide special transit service to its campus. To serve commuters from the East Bay, Stanford has entered into a cooperative agreement with the Alameda-Contra Costa Transit Authority (AC Transit) to run the Line U East Bay Express, which is a peak-period bus service between Stanford and the Bay Area Rapid Transit (BART) system, the ACE train, and East Bay park-and-ride lots. Commuters with a Stanford ID badge have free and unlimited access to the Line U, but other riders can pay AC Transit's fare and utilize the service as well. The Line U carries around 500 passengers per day and Stanford contributes 30 percent toward fare box recovery.

The success of this new regional partnership has allowed the university to pursue similar arrangements to make additional connections with BART as well as new park-and-ride lots in the East Bay. The most recent example of this was implemented in 2015 and is the extension of the Marguerite Ardenwood Express line to additional stops in Fremont to supplement the Line U service. The funding to extend the Ardenwood Express was provided on a pilot basis by Stanford Hospital and Lucile Packard Children's Hospital, whose employees form a significant portion of ridership on both the Line U and the Ardenwood Express. This model of developing and sharing the cost of providing special transit routes could certainly be applied to other contexts where there is a large cluster of employers or visitors.

In addition to providing the on-campus transit system, Stanford operates a Marguerite shuttle service that connects to the regional transit hub at the Palo Alto University Avenue Caltrain Station. The expansion and improvement of Caltrain's commuter service between San Jose and San Francisco since Stanford began many of its mobility management programs has been complementary to the university's goals. Caltrain ridership has accounted for the single largest increase in employee participation in alternative transportation commutes during the last decade.

Key Insights for Peers and Communities

- **Cities, counties and regional entities can influence the creation of a multimodal mobility management program like Stanford's by creating agreements with large employers, development districts, and universities to limit traffic growth.** Most of Stanford's success in reducing its drive-alone rate came after the university entered into an agreement with the County of Santa Clara that it would hold its traffic constant despite any new development.

- **Social marketing in the form of fostering a commuting community shows potential for improving participation and expanding the reach of mobility management programs.** Similar to many successful university programs that target travel behavior shifts, Stanford has employed a campus-wide Commute Club. The program both builds a community of commuters and facilitates the development of mobility management programs to better serve alternative transportation users.

- **By partnering with a transit agency to pay for pilot transit service, large employers, business districts, or universities can take more control over their transit service**. Stanford is active in partnering with regional transit agencies by paying in part for special transit service to campus from outlying transit hubs during the peak hours. This service is paid for through development fees and parking savings.

- **Accounting for lifecycle cost of providing parking.** Similar to MIT, Stanford accounts for the estimated cost of providing parking for any new development and transfers those funds to its commuter programs, rather than providing the parking space.

- **Parking "cash out" programs are effective at reducing driving.** Stanford pays commuters to not drive to campus, an approach similar to parking "cash out" programs. Parking revenues help to fund the program.

In 2000, Santa Clara County issued a General Use Permit to Stanford. Among the mitigation measures to reduce the impact of development, the university agreed to mitigate impacts of campus growth by either reducing vehicle trips or paying for infrastructure to accommodate more trips. A few of the close to 100 mitigation measures that the university has agreed to are related to transportation. In keeping with the issuance of the GUP, the university established its goal of no net new peak commute trips from all new development. The much expanded TDM program and the expansion of the campus shuttle are examples of the university's commitment to its goal, which, eased traffic problems, and helped to meet its air quality and sustainability goals according to Stanford Parking & Transportation Services staff.

There are many areas in metropolitan regions throughout the United States that face development pressure and increasing property values in their most attractive areas. Like Stanford, these areas typically have high peak period traffic congestion. These regions could explore pursuing policies like those of the County of Santa Clara to require development to be served by a travel demand management plan to limit new trips. Stanford's experience with the General Use Permit for development has shown that such a policy creates many winners and few losers. The region is able to

manage congestion without building expensive new infrastructure, and land previously dedicated to parking can be repurposed for much more productive uses.

Perhaps the most notable feature of Stanford's program is its Commute Club program. This program uses the incentives approach to managing transportation demand. Commuters can choose to pay to drive alone and park or be paid to not drive alone to campus, similar to "parking cash-out" programs introduced by Dr. Donald Shoup.[38] Parking structures are expensive to build and to maintain but they also have an opportunity cost that is rarely factored in. By taking account of the opportunity cost of maintaining parking instead of dedicating it to higher value uses, providing financial incentives for commuters who do not drive makes fiscal sense.

As a private employer, Stanford and other universities or companies can pursue programs like this since they have a clearer opportunity to directly control their costs and benefits. This kind of program would be more complicated to pull off for a regional entity. But States, regional entities and cities could analyze land use in high value districts and calculate the opportunity cost of maintaining existing parking, which could result in the adoption of innovative programs like offering the ability for workers to cash out their parking spaces for a fraction of the monetary value of that parking space, or to tax parking spaces provided by employers while simultaneously allowing them to deduct the expense of providing commuter services.

Finally, Stanford is endowed with a multitude of skilled engineering students and professors who have created technologies to assist Stanford's mobility management program. In addition to the alternative commute schedule game, students and faculty have created a real-time GPS app for the campus shuttle bus. While universities are certainly unique environments dedicated to innovation in ideas and technology, transportation management organizations serving other kinds of business clusters may also be able to tap the potential of the talent within its membership to help build new solutions to mobility problems.

Stanford's impressive success at limiting vehicle traffic to campus while it has grown over the last fifteen years has many lessons for the benefit of cities, MPOs, business improvement districts and large employers. While Caltrain service increased during this same time period, it alone cannot explain the vast increases in the use of transit and bicycling. The impetus for the improvements to transportation at Stanford stem from the agreement with the County to limit trips from any new development and the monetization of land use decisions that deflected the cost of providing parking for new development and applied it to incentives for bicycling, carpooling, vanpooling, transit and other alternatives to driving alone. Stanford has not spent less through this comprehensive approach than it might have if it chose to fund intersection improvements instead of limiting trip growth, but the university has significantly increased the productivity of its highly-valuable and limited land.

For More Information

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[38] http://shoup.bol.ucla.edu/

University of California, Berkeley (UC Berkeley)
Berkeley, California

Description of the University

The University of California, Berkeley is the oldest public university in California and is located adjacent to the downtown section of the East Bay community of Berkeley on the western slope of the Berkeley hills (Figure 12). Its 1,232 acre campus has a daily population of roughly 51,000 people with 37,000 graduate and undergraduate students and nearly 14,000 faculty and staff (Table 8). The historic campus is connected by landscaped walking paths but includes numerous connecting roads and buildings which interface with the surrounding city. One notable feature of the campus is its hilly topography. The lower campus is on the west side and is adjacent to downtown Berkeley, and the campus slopes upward to the east to the upper campus. There has been more development pressure on the university campus, particularly on the Lower Campus near downtown.

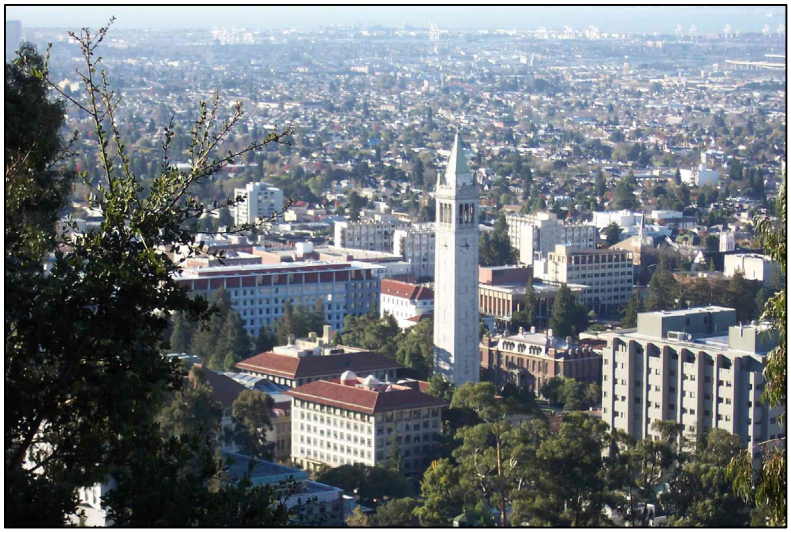

Figure 12: UC Berkeley Campus
Source: Wikipedia/introvert

Table 8: Characteristics of UC Berkeley and San Francisco Bay Area Commuters

	University of California-Berkeley (UC Berkeley)	San Francisco – San Jose, CA Combined Metropolitan Area
Population:	51,000 (students/faculty/staff)	8,470,000
Percent of Students Living On-Campus:	27%	n/a
Neighborhood/Regional Context:	Urban	Large (1 million +)
Public Transportation Context:	Heavy Rail, Local Bus, Express Bus, Campus Shuttle	Heavy Rail, Light Rail, Commuter Rail, Intercity Passenger Rail, Local Bus, Express Bus, Intercity Bus, Ferry Boat
SOV Commute Share:	17%	72%
Carpool/Vanpool Commute Share:	4%	11%
Public Transportation Commute Share:	17%	10%
Walk/Bike/Other Commute Share:	62%	7%

SOURCES: UC Berkeley and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

Community/Regional Context

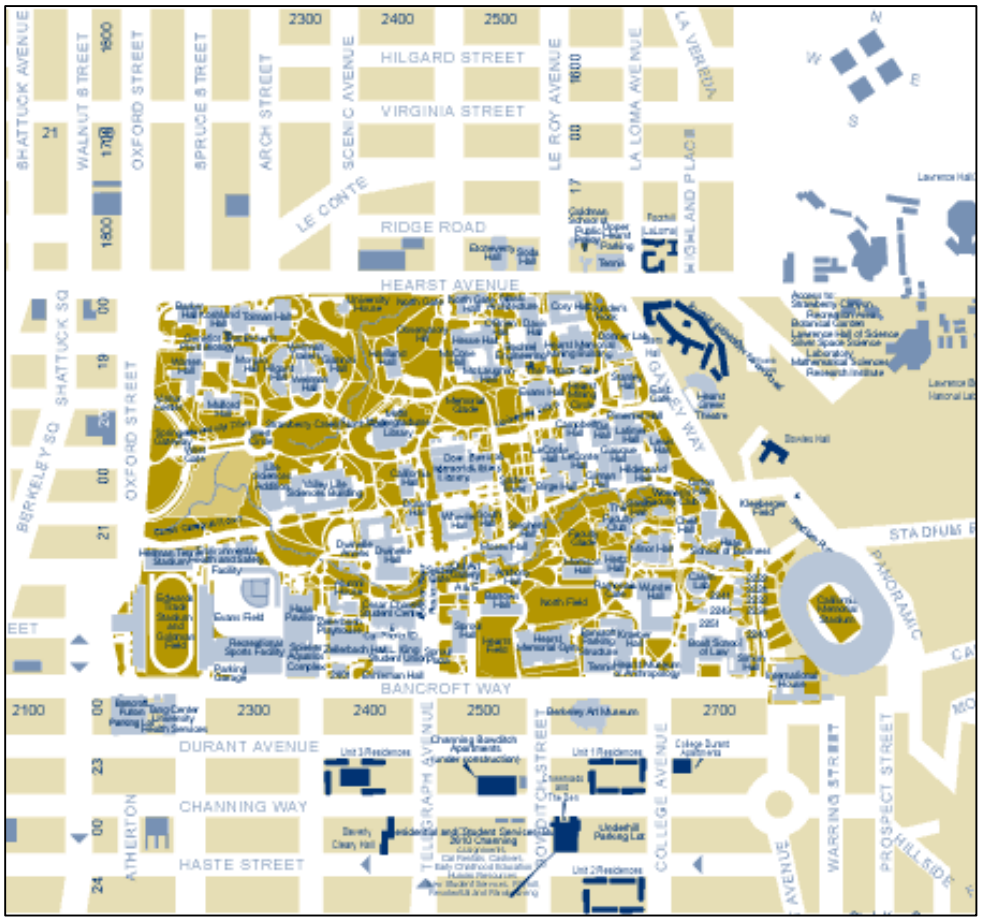

Figure 13: UC Berkeley Campus Map
SOURCE: UC Berkeley

UC Berkeley has an urban campus in a neighborhood with a pedestrian orientation. The city of Berkeley (pop. 112,580[39]) has the flavor of a "college town" but is also a major economic and cultural center within the San Francisco Bay Area. It is bordered to its south by Oakland and Emeryville and to the north by Albany and El Cerrito. Most of the city has a fairly grid-like roadway network typical of American cities which developed in the early and mid-20th century, though the hill neighborhoods on the north and east side are less connected (Figure 13). The university is well-served by two main transit systems. Alameda Contra Costa County Transit District (AC Transit) operates buses to Berkeley, Oakland and surrounding communities in Alameda and Contra Costa counties. The Bay Area Rapid Transit (BART) system is a rail rapid transit system that connects Berkeley with San Francisco, Oakland, and Richmond, as well as more suburban communities several miles to the south and east.

In recent years, Berkeley has been an early adopter of methods to retrofit its roadway grid for easier and safer bicycle mobility. Many of its busier arterial roads have bike lanes and Berkeley was one of the first

[39] US Census. 2010 Demographic Profile

cities to install traffic calming in neighborhoods and well-marked "bicycle boulevards" – a technique of retrofitting lower-volume residential streets that parallel busy arterials for safer riding.

University Transportation Issues and Trends

Because UC Berkeley is well-served by public transit and many students live either on campus or in nearby East Bay communities, it has one of the country's lowest student drive alone rates among universities. 95 percent of all students commute by a mode other than driving alone and 57 percent of faculty and staff do so as well. These figures are significantly higher than in 1990 when only 40 percent of faculty and staff commuted by a mode other than driving alone and 84 percent of students did so. Yet despite the low driving rate of the campus population, the campus still faces a parking availability shortage at peak times of day in certain portions of the campus that is projected to get more acute in the coming years as many parking locations are slated to be developed into new campus buildings. As a result, the current transportation program is exploring ways to manage the projected shortage in parking availability by trying to help drivers switch to alternative commute modes and encouraging parkers to use available spaces in the less popular parking facilities in the hiller areas of campus. This latter effort has been a challenge as the farther flung parking spots in the higher elevations are not popular even when the university has offered them to campus parkers for free. Additionally, most campus parking is full in the middle of the day on most weekdays, and visitors who drive park in nearby non-campus parking or on public on-street parking.

UC Berkeley's Current Transportation Programs

UC Berkeley's transportation program is funded by student fees, sales of parking permits, daily parking revenue, and faculty and staff transit pass sales. The fees fund the travel demand management programs and the maintenance of transportation facilities. The university includes variable rate parking where monthly parking permits range from less than $30/month per person in a carpool to over $125 per month for a single parking pass. UC Berkeley offers students a free unlimited transit pass on AC Transit, discounts on BART fares, and free shuttle bus service around campus and to the BART station on Bear Transit.

Students can receive an unlimited transit pass on AC Transit in the form of a sticker on their student IDs. The pass program is funded by a student fee paid each semester. Faculty and staff are eligible to take advantage of discounted AC transit passes and a monthly BART subsidy. Additionally, annual parking permit holders are eligible for a free AC Transit pass. UC Berkeley also provides faculty and staff the ability to pay for transit passes and parking via a pre-tax payroll deduction. All campus affiliates are offered guaranteed ride home services through a partnership with the County as well as discounted membership to local car sharing companies and Enterprise rental cars. For bicyclists the campus offers many convenient bike racks as well as seven secure cages and eight Bike Link lockers for bike parking. The campus does not have a vanpool program but offers ride matching services through Zimride.[40]

[40] https://www.zimride.com/

Innovative Policies and Technologies

UC Berkeley provides deeply discounted, unlimited AC Transit passes to students in the form of a sticker on the student ID called the Class Pass (Figure 14). The passes are funded by student fee assessed each semester. This has been highly popular. By including the transit pass as part of the student ID, students do not need to take any action to take advantage of the transit benefit. The number of students using transit has increased since the Class Pass program began.

Figure 14: "Class Pass"
SOURCE: UC Berkeley

UC Berkeley has recently installed three Transit Screens in buildings across campus with large concentrations of students and/or staff. The screens provide campus affiliates with real time transit info for all transit providers that serve the campus area. The screens are an effort to make getting transit information to campus affiliates easy and efficient. The screens are also displayed on the Parking & Transportation website for convenience.

UC Berkeley is working with the Metropolitan Transportation Commission, the MPO for the region, to incorporate Clipper Card[41] technology into the student passes. The Clipper Card is a regional fare payment program that works on multiple transit agencies in the Bay Area. This effort has been complicated by the fact that the region is in the process of upgrading to a new regional transit pass technology, but this new pass will not likely be available for a few years. UC Berkeley has not yet been able to negotiate a fare discount on the BART system because the distance-based fare structure is difficult for BART to price.

The transportation program has also conducted detailed studies of its parking management and travel demand management to refine and expand programs based on observed behavior. Every three years, campus conducts a student, faculty and staff transportation survey to collect information on mode split, as well as data on its various transportation programs. UC Berkeley also offers attendant parking to increase the efficiency and use of available lot and garage space and offers parking permit discounts to carpool participants for their participation in a carpool.

Figure 15: paybyphone label
SOURCE: UC Berkeley

UC Berkeley has recently started to introduce "pay-by-phone" technology[42] for all public parking on campus, which will allow speedy payment and give parking managers better data about the availability of parking spaces (Figure 15).

[41] https://www.clippercard.com/ClipperWeb/index.do
[42] https://www.youtube.com/watch?v=DAZbj9TSknQ

UC Berkeley is exploring wayfinding technologies to show drivers where parking is available, which would reduce driving within the campus area. The goBerkeley program[43] may provide a model for doing this, and the UC Berkeley program is currently working with an FHWA grant to test it. This program uses technology to manage time limits and cost of garage and street parking based on demand for it with the goal of keeping 15 percent of parking spaces open at any time. However, the technology is fairly expensive at the moment, and since most Berkeley commuters are regular commuters to the area, this model may not be as relevant as for area since many regular campus commuters adapt and learn where and when parking will be available when they arrive at campus. UC Berkeley is currently exploring allowing permit holders to pay for daily parking instead of a monthly or annual permit.

UC Berkeley also understands the importance of connecting efforts to increase student housing in a way that will result in no new car trips to campus. In the campus Long Range Development Plan, the university identified areas within a 20-minute transit ride to campus as priority areas for new campus housing development. Since 2005, the university has added a significant number of new beds for undergraduates in the Southside neighborhood, a highly walkable neighborhood within four blocks and a ¼ mile from the campus. The university has also supported City of Berkeley efforts to increase development and new housing near campus.

Key Insights for Peers and Communities

- **There is a commuting population for which higher driving costs will not deter driving**. UC Berkeley has been enormously successful at convincing its community members to rideshare, walk and bicycle as is evident by its exceptionally low single-occupant vehicle driving rate. However, intense efforts to reach the remaining drivers have proven to be difficult.

- **A strong relationship with the local transit system has resulted in exemplary coordination** and strategic influence for the university.

- **Employing "pay by phone" technology** for all of its parking garages is both convenient for customers and allows for better data collection on daily parking uses.

By conducting a detailed study of the campus's mobility management programs and parking management, UC Berkeley has been able to strategically allocate resources toward developing alternatives. However, the university's program has determined that there are many people who will continue to drive even with incentives to use other modes and is currently working to understand the minimum number of parking spaces it needs to provide for these commuters.

UC Berkeley recently tried to engage approximately 200 drivers to campus in a face-to-face marketing campaign. This effort involved UC Berkeley parking and transportation staff meeting drivers and offering to develop a tailored commuter program for each individual. This time-consuming effort resulted in very few new members to its non-drive alone commute programs and was not continued. (However, campus continues to do transportation and commute outreach at new employee and student orientation

[43] http://www.goberkeley.info/about.php

programs). A similar effort to exchange parking permits for high-demand parking spaces for free parking permits on the under-utilized Upper Campus resulted in only 20 switches. It is possible that economic incentives will not deter some members of the community who can afford the high cost of parking, or that their personal situation requires that they drive to work each day. While the UC Berkeley campus maintains an extremely low parking supply rate (0.1 spaces per registered student, faculty and staff member) compared to its peer institutions and other UC campuses, its transportation program expects to maintain a certain number of parking spaces for both regular commuters and for visitors to the campus' public academic, artistic and athletic programs.

UC Berkeley has been on the forefront of utilizing smart phone technology to provide commuters with better service and simultaneously better manage parking demand. By equipping parking garages (Figure 16) with technology that allows commuters to pay by phone, the university has better data about parking availability and usage.

Because the UC Berkeley community is the largest single customer on the AC Transit system and the largest generator of commute trips in Alameda County, they have some influence over transit service planning decisions. Any large organization such as a large single employer, or a collection of employers like a business improvement district or transportation management organization may find itself with similar influence if they build enough ridership demand among their members.

Figure 16: Campus parking garage
SOURCE: UC Berkeley

While UC Berkeley is fortunate to be located on a major transit corridor, its exceptionally low drive alone rate is a result of the package of transportation offerings and parking innovations the university has engaged in. Through embracing technology such as Class Pass transit card, and the "pay by phone" parking option, the university is both easing the mobility experience of commuters and giving it better data to improve the efficiency and quality of transportation on campus. Cities, MPOs, business improvement districts and large employers can look to UC Berkeley as a successful model of centralized mobility service provision and transportation marketing of a variety of options tailored to distinct categories of travelers.

For More Information

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University of California, Los Angeles (UCLA)
Los Angeles, California

Description of the University

UCLA is a large public university on the west side of Los Angeles. It is the largest university in California with an enrollment of more than 43,000 students, more than 29,000 undergraduates and nearly 14,000 graduate students and interns. The university has a sizeable residential population of roughly 13,000 students, with the remainder commuting from various points in the metropolitan area (Table 9). The main UCLA campus is largely self-contained and its academic, student life, and administrative buildings are connected with walking and bicycle paths and public green space. The university campus (Figure 17) is constrained to 419 acres but has experienced significant development within its boundaries in the last few decades. According to UCLA's Department of Capital Programs, nearly fifty new buildings or building complexes, five new parking facilities (and expansion of two others), and twenty-five major building additions have been constructed on campus since 1986, and the university has several new developments in the pipeline.

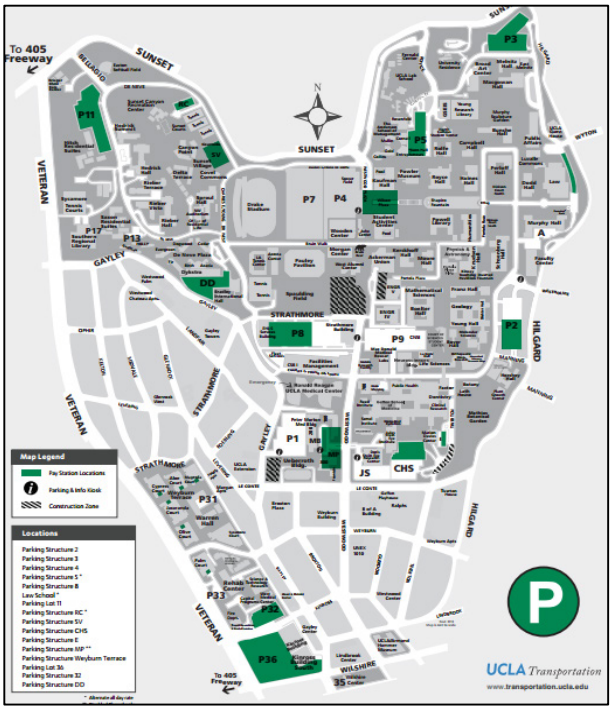

Figure 17: UCLA campus map with self-service parking lots and structures
SOURCE: UCLA Transportation

Table 9: Characteristics of UCLA and Los Angeles Metropolitan Area Commuters

	UCLA	Los Angeles, CA Metropolitan Area
Population:	73,000 (students/faculty/staff)	12,875,000
Percent of Students Living On-Campus:	38%	n/a
Neighborhood/Regional Context:	Suburban	Very Large (10 million +)
Public Transportation Context:	Local Bus, Express Bus, Campus Shuttle	Commuter Rail, Heavy Rail, Light Rail, Intercity Passenger Rail, Local Bus, Express Bus, Intercity Bus
SOV Commute Share:	36%	78%
Carpool/Vanpool Commute Share:	10%	11%
Public Transportation Commute Share:	22%	6%
Walk/Bike/Other Commute Share:	32%	5%

SOURCES: UCLA and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

Community/Regional Context

UCLA is situated in the far west side of the City of Los Angeles in the Westwood neighborhood near the major intersection of Wilshire Boulevard and I-405 (Figure 18). UCLA is one of several major employment and cultural centers on the west side, and the attractiveness of the area combined with its automobile orientation and lack of major transit infrastructure has resulted in highly congested traffic conditions on I-405 and arterial streets for much of each day.

While UCLA is conveniently located near one of Los Angeles's busiest freeways and freeway junctions, access to the university is not yet served by the region's growing rail rapid transit system. However, access to the university is provided by several bus transit providers including Santa Monica Big Blue Bus, Culver CityBus, LA Metro, and a handful of long distance express buses provided by the Los Angeles Department of Transportation, Santa Clarita Transit, and Antelope Valley Transportation Authority.

Figure 18: A bird's eye view of the UCLA campus in Westwood, Los Angeles
SOURCE: UCLA

University Transportation Issues and Trends

According to UCLA's annual State of the Commute report, UCLA has more than 59,000 daily commuters including over 29,000 faculty and staff and roughly 30,000 off-campus students. Like many major universities throughout the country, UCLA has been experiencing some growth in enrollment, employment and land use development on campus. Despite this growth, UCLA has witnessed an overall decline in car trips to campus during the last decade. UCLA has been collecting cordon counts of vehicles

at entrances to campus since 2003. In 2014, the number of vehicle trips to and from UCLA averaged near 100,000 vehicles per day, which was an overall reduction of more than 20 percent since the cordon counts began. But as the increasing development, employment, and enrollment levels indicate, the decrease in vehicle travel to and from campus does not relate to a decrease in overall travel activity. Instead, to an impressive degree, UCLA has managed to increase the numbers of commuters who use means other than driving alone to accommodate growth on campus.

Just over half of employee commuters to UCLA drive alone to campus while only one fifth of commuter students do so. By contrast, close to three quarters of commuters in the Los Angeles-Long Beach metropolitan statistical area drove alone, according to the 2010 Census. Instead, UCLA commuters have opted for public transit, ridesharing, walking and bicycling to a far greater degree than their peers in the region (Figure 19).

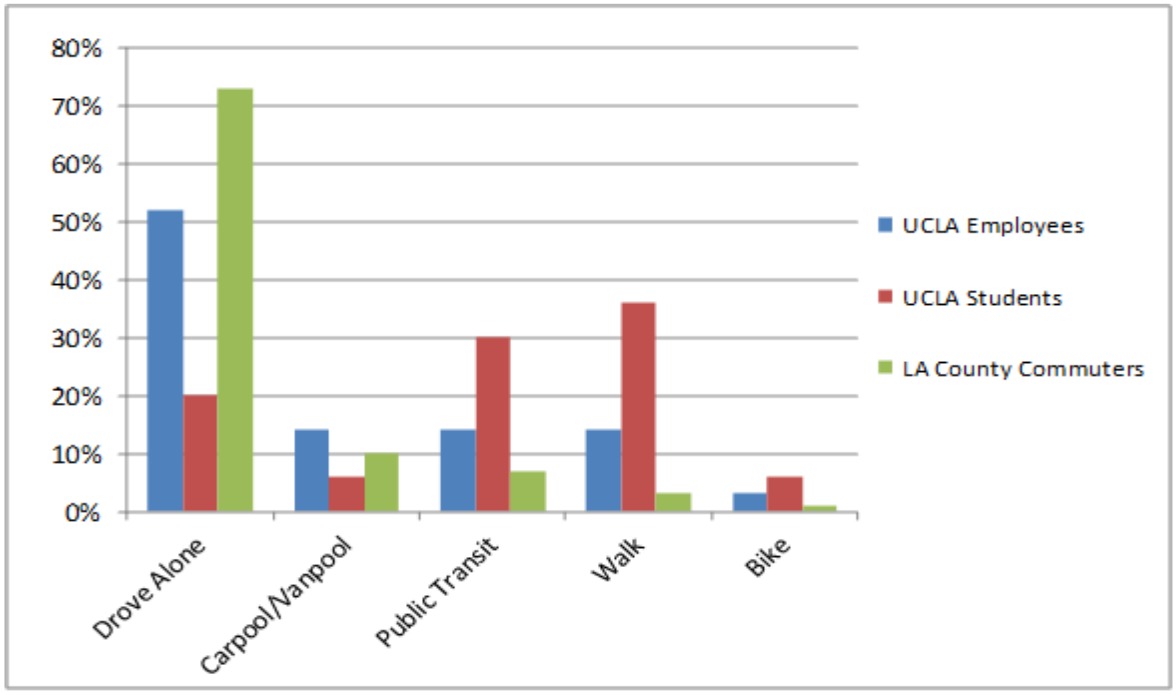

Figure 19: UCLA Commute Mode Split Compared to Los Angeles Metropolitan Area, 2013
SOURCES: UCLA, and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

The comparatively low drive alone rate for UCLA employees is similar to that of daily commuters to Downtown Los Angeles, the hub of the region's extensive commuter and Metro Rail system. According to the Downtown Center Business Improvement District's 2013 survey[44] of employees in the area, survey respondents who were commuters to Downtown Los Angeles indicated a drive alone rate of close to 50 percent. That UCLA has a similarly low proportion of commuters who drive alone without being served by major transit infrastructure is likely the result of characteristics of the campus

[44] Downtown Center Business Improvement District, Demographic Study 2013: https://www.downtownla.com/images/about/DCBID_2013_Annual_Report_updated.pdf

community and the extensive efforts of UCLA's award-winning transportation demand management (TDM) program.

UCLA's Current Transportation Programs

UCLA had one of the first campus transportation demand management programs in the United States. Through the TDM program, the university offers incentives to faculty, staff, and students to commute by any mode other than driving alone.

The university offers a transit pass subsidy of 50 percent for students, faculty and staff. It also offers a free campus bus shuttle that provides transportation within campus. Like most campus TDM programs, UCLA promotes ride matching for carpools through Zimride.[45] It also uses the online service to match commuters to vanpools. The university operates one of the oldest campus vanpool program in the country, which has one of the largest participation rates among its national peers. For between $110 and $300 per month (depending on distance from the university), commuters are guaranteed a seat on a vanpool that takes them from their neighborhood to the university. For a reduced fee, commuters can become vanpool drivers. The university requires a short orientation for any commuter interested in joining a vanpool using one of the university's vans (Figure 20).

Figure 20: UCLA has a fleet of free campus shuttles and operates a vanpool program
SOURCE: UCLA Transportation

Carpools are encouraged by the program through the offering of discounted parking to registered carpools. There are different monthly parking rates for 3-person and 2-person carpools. For a 3-person carpool, the parking pass for the vehicle is almost 1/3 the cost of a regular monthly parking permit, so the per-person cost of the permit is even lower ($12 vs. $96) for an annual savings of more than $1000.

To encourage bicycling, the university has provided a bike shop that offers parts, repairs, and maintenance classes and has installed over 3,000 bicycle racks. The university offers a bike library where campus community members can rent a bicycle long term and the university is exploring the possibility of starting a formal bike share program on campus. Between 2006 and 2014, the number of daily cyclists on campus has grown from 2,600 to 3,100. The university also promotes walking by marketing its health benefits and encourages faculty and staff to have walking meetings and to walk to nearby Westwood for lunch or errands rather than driving.

[45] https://www.zimride.com/

Innovative Policies and Technologies

UCLA has consolidated its alternative transportation programs under the umbrella of a social marketing tool called the Bruin Commuter Club. Commuters become eligible for membership in the Bruin Commuter Club if they use any of the modes that the university promotes. Membership in the club includes benefits such as discounted occasional parking rates (for when you need to drive), emergency ride home service, and monetary and promotional entertainment certificates for faculty and staff. The university offers membership to Zipcar[46] to faculty and staff in the Commuter Club, which includes 12 hours of driving time each quarter free of charge.

The benefits offered to members in the Bruin Commuter Club have incentivized participation in it, which helps the university's TDM program to communicate about transportation options and issues to commuters. The formation of the club has been a successful strategy to bring all of the commute modes together. By being a member, commuters can easily switch their commute patterns when aspects of their lives make a different commuting option more viable. It also provides a seamless way to communicate to commuters about new alternatives and programs keeping existing customers informed. The Bruin Commuter Club has also served as a social network for the commuters to campus and is enhanced with campus-wide games and contests related to green commuting or active transportation. These games and contests are popular and boost awareness of transportation options.

According to the Association of Commuter Transportation[47] and case study contacts, the vanpool program is one of the most successful in the country in terms of participation. UCLA has over 150 registered vanpools. While the success of Zimride in matching carpool members is not known because the university does not get reports on matches made using it, the vanpool module within Zimride has been successful as it works as a social media tool that helps customers to connect and see information about available routes and wait lists for existing vanpools.

UCLA has geocoded all staff and faculty addresses and uses that information to determine which programs are best suited to each commuter. By using a geodatabase, UCLA is able to apply much more targeted and effective marketing to faculty and staff. For instance vanpool programs are only marketed to commuters whose home locations are at least 20 miles from campus, while those living less than 2 miles from campus are encouraged to walk or bicycle.

While the vanpool program is the largest in the country, the mode with the largest increase in use in recent years has been bicycling. UCLA has supported this mode by increasing bicycle parking, managing a campus bike shop and bike library. UCLA is working with the City of Los Angeles to find ways to improve the environment for bicycling in the areas near campus that have poor conditions for bicycling.

UCLA has been out ahead of State and local requirements for reducing vehicle emissions and trips. The university has an agreement with the City of Los Angeles to limit trips. While the requirement to limit trips no longer applies, the university still holds itself to staying well under the trip cap established in

[46] http://www.zipcar.com/
[47] http://actweb.org/

1990. The campus transportation program has reduced trips since 1990 even while development on the campus has grown close to 40 percent.

Key Insights for Peers and Communities

- **UCLA's suite of multimodal demand-oriented transportation options resulted in a similar drive-alone rate as transit-rich downtown Los Angeles**. By creatively targeting the unique needs of different types of commuters to the university, UCLA has reduced driving without a major transit investment.

- **UCLA utilizes social and geographic-specific marketing to target** the right kinds of transportation alternatives to its community members using the geocoded addresses of all staff and faculty residences in order to tailor alternatives available to each individual.

- **The university offers community members benefits for being a part of the Bruin Commuter Club**. This marketing outreach allows the university transportation program to reach them more easily with announcements and other information.

- **High SOV parking rates partially subsidize the cost of providing alternatives** for those that forego driving alone.

- **Technology has helped improve ride matching for the vanpool program**, one of the most successful in the country.

UCLA is notable for the success it has achieved in reducing vehicle trips to and from campus during the last 25 years even while the university has expanded. Further, UCLA is not a downtown campus and is not served by rapid transit, so UCLA's comparatively high rates of ridesharing, transit, and nonmotorized commuting are likely due in large part to the coordinated and targeted marketing efforts of its transportation program and the attractiveness of travel alternatives provided in combination.

Areas with a comparable density of employment and activities may be able to achieve similar success if they were to engage in the comprehensive and balanced types of activities that UCLA has mastered. Some of these strategies, such as geographic-specific marketing, variable-rate parking, or using parking to fund alternatives, may be more challenging in environments that have diffuse employers and property owners due to the lack of centralized control over parking facilities and inaccessible data about commuters.

Some of these challenges could be circumvented, however, by employing a strategy similar to the creation of the Bruin Commuter Club. By bringing all types of commuters together into a single portal through the use of incentives and communication benefits, transportation management organizations and similar groups operating in non-university areas may be able to earn the same level of access to information about commuters that is taken for granted by universities. The commuter club strategy is not a technology itself. However, building an organization like it could potentially lay the foundation of a

customer base for emerging private sector information technology applications that provide real-time information about transportation options including ride matching, transit, taxi services, and other strategies.

Like many other universities profiled in this report, UCLA has employed parking management strategies aimed at encouraging ridesharing. These strategies are self-sustaining because drivers of single-occupant vehicles pay a premium, effectively subsidizing the trips of those who arrive as passengers or drivers in a carpool or vanpool. Revenues from publicly-owned parking facilities could also be re-allocated to the promotion of alternative transportation such as supplementing employer-sponsored discounted transit passes. As one administrator at UCLA put it, "everyone participates in the alternative transportation program, either by taking advantage of rideshare and transit incentives or paying for those incentives by driving alone." Employment and activity centers in many regions throughout the country are seeing a reduction in the supply of inexpensive parking spaces as these locations are converted to more productive uses. By using economic principles to more proactively manage demand for car travel, combined with attractive travel alternatives as provided by UCLA, these regions will be able to better plan for and absorb increases in travel demand due to growth in development, population and employment without increasing vehicle trips and congestion.

For More Information

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Seattle, Washington

Description of the University

The Seattle campus of the University of Washington (UW) is the largest university campus in the State of Washington, covering more than 700 acres and home to more than 44,000 students. With faculty and staff included, the campus community exceeds 71,000 people (Table 10). The campus is home to the University of Washington Medical Center (UW Medical), a major regional hospital, and it also regularly hosts major intercollegiate athletic events, the largest of which draw up to 65,000 attendees. The majority of students (84%) live off-campus as do the more than 27,000 faculty and staff (including UW Medical staff). UW is a major research university with a large commute-shed which extends throughout the Seattle metropolitan area.

Table 10: Characteristics of UW and Seattle Metropolitan Area Commuters

	University of Washington, Seattle (UW)	Seattle, WA Metropolitan Area
Population:	71,000 (students/faculty/staff)	3,610,000
% of Students Living On-Campus:	16%	n/a
Neighborhood/Regional Context:	Urban	Large (1 million +)
Public Transportation Context:	Local Bus, Express Bus, Shuttle Bus, Light Rail (planned 2016)	Streetcar, Light Rail, Monorail, Commuter Rail, Intercity Passenger Rail, Local Bus, Express Bus, Ferry Boat
SOV Commute Share:	18%	73%
Carpool/Vanpool Commute Share:	7%	10%
Public Transportation Commute Share:	40%	10%
Walk/Bike Commute Share:	34%	7%

SOURCES: UW and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

UW is located approximately 4 miles northeast of downtown Seattle, across the Lake Washington Ship Canal. Much of the campus is located on a peninsula surrounded by the ship canal and Union and Portage Bays (Figure 21). Seattle's University District neighborhood borders the campus to the West and North. The UW campus is unusually well-served by public transportation given its distance from downtown. Nearly 60 bus routes serve the campus and surrounding district. 2016 will see the opening of a new light rail extension connecting the campus to downtown, the dense Capitol Hill district, neighborhoods in south Seattle, and the airport.

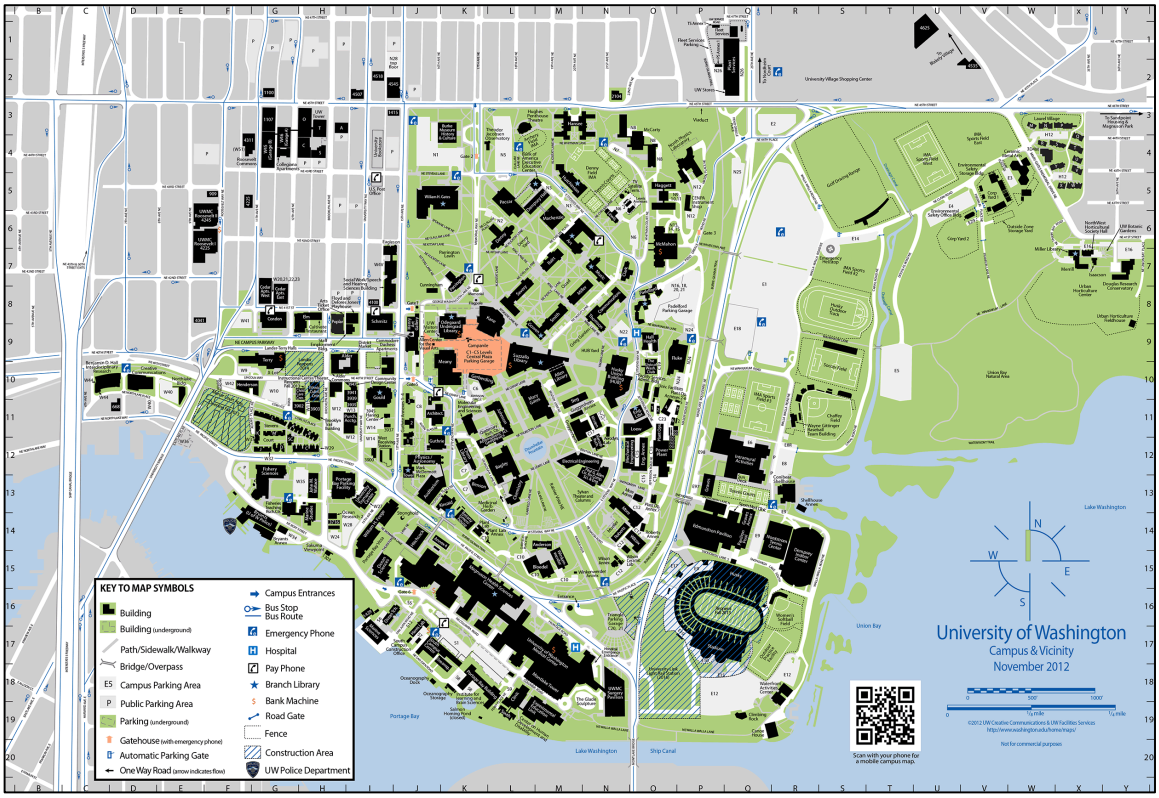


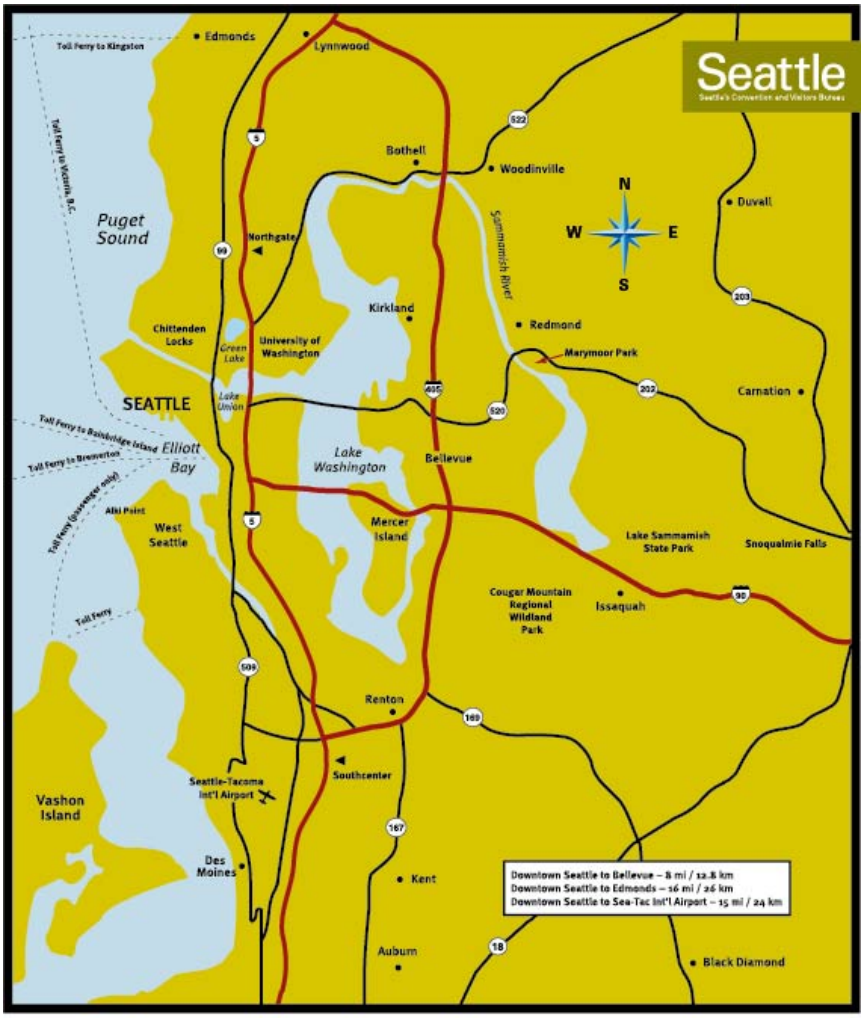
Figure 21: Map of the UW campus in 2012
SOURCE: University of Washington

Community/Regional Context

The Seattle metropolitan area has a unique topography. The City of Seattle sits at the core of the region on a narrow stretch of land between Puget Sound to the West and Lake Washington to the East (Figure 22). Development extends north and south of Seattle along the Puget Sound and east across Lake Washington to the Cascades mountain range. There are also several developed areas on the western shore of Puget Sound which are linked to the rest of the metropolitan area by an extensive system of ferries. The region's hilly terrain and large lakes pose transportation challenges and have perhaps supported the region's dense urban core. There are only two bridges crossing Lake Washington connecting Seattle with the western suburbs and the narrowness of the band of land on which Seattle sits creates somewhat of a bottleneck in the regional transportation network. UW is located just north of the Washington State Route 520 (SR-520) toll bridge over Lake Washington.

The region is well-served by public transportation, provided by seven different agencies. Buses provide the majority of transit capacity in the region, with extensive local and express services. In recent years rail service has been re-established with both light rail and modern streetcar services in Seattle and connecting to the Seattle-Tacoma International Airport. Extensions of both systems are planned, including the light rail connection to the University of Washington campus in 2016. The region is also served by a burgeoning commuter rail system that connects more distant areas of the region with downtown Seattle.

Seattle is a high population growth area, experiencing double-digit percentage population increases each of the past several decades. The majority of the population growth in recent years has been in suburban areas, while the core has remained stable. As in many large cities, commuting by car is less common in the dense core of the area than in it is in the more recently-developed suburban growth areas, which are much more auto-oriented. However, the University District, located adjacent to UW has some of the densest residential areas of the city. Furthermore, the city, business community, and the Puget Sound Regional Council (PSRC), the Seattle area metropolitan planning organization, has targeted the district as a growth area, and it is an active area of new development. In many cases UW is a participant in the policy work around redevelopment in the area and in some cases is a partner in redevelopment projects there.



Due in part to its high density and unique geography, the Seattle metropolitan area has some of the highest traffic congestion in the U.S.[48] The region is addressing congestion and related environmental concerns in a number of ways. The State of Washington passed the Commute Trip Reduction (CTR) Efficiency Act in 2006, an update to the original 1991 law, which aimed to reduce SOV travel to major employment sites by 10 percent by 2011 and associated vehicle miles traveled (VMT) by 13 percent.[49]

The State has set an ambitious greenhouse gas emissions mitigation agenda which seeks to return emissions to 1990 levels by 2020 and to 50% below 1990 levels by 2050. CTR is a central part of the State's strategy to achieving these targets. As part of CTR implementation, the State also provides

[48] http://mobility.tamu.edu/ums/
[49] http://www.wsdot.wa.gov/Transit/CTR/overview.htm

significant support for vanpools, which experienced a dramatic 41% ridership increase from 2003-2007.[50] UW's greenhouse gas reduction commitments are even more ambitious than those of the State, with a commitment to be carbon neutral by 2050, a commitment shared with the City of Seattle.

University Transportation Issues and Trends

UW has experienced marked success in shifting from an SOV-heavy mode split to one that is much more reliant on other options. More than 40% of UW commuters arrive on campus via public transportation, which is subsidized by UW through its nationally-renowned U-PASS program. Because of its location in the dense University District, much of the remaining commuter population walks or bikes to campus (more than 33%) and of the remainder; over a quarter utilize carpooling or vanpooling options. Together, these options have allowed UW to achieve an SOV rate of below 18% (Figure 23).

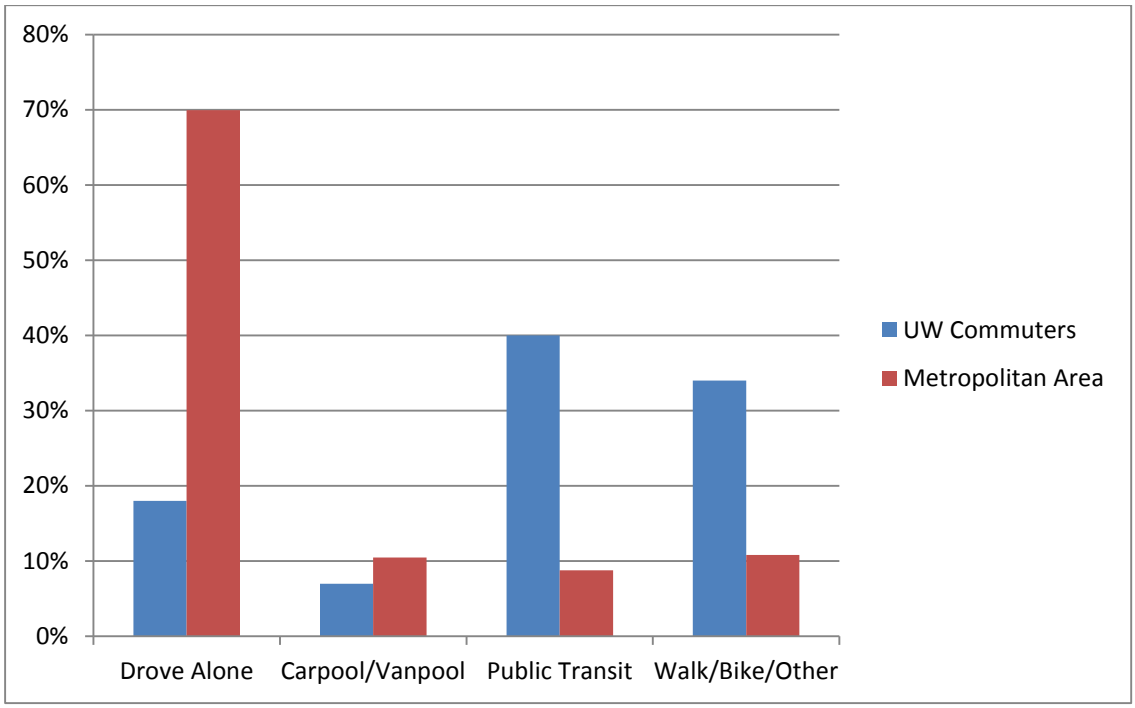


Figure 23: Comparison of UW Commute Share to Seattle Metropolitan Area, 2013
SOURCES: UW and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

In the early 1980's UW growth had resulted in increasing traffic concerns from neighboring residents and businesses. This led to an agreement between the City of Seattle and UW in 1983, which requires the university to stay within certain vehicle trip and parking space caps, providing a policy foundation for UW's TDM program. In 1991, the Statewide CTR provided a statewide incentive, which did not raise the bar for SOV reduction at UW, but which helped support the development of a robust regional transit network and significant regional bicycling amenities which UW commuters utilize. More recently, statewide and UW commitments to significantly reduce greenhouse gas emissions have provided increased justification and urgency for UW's efforts to reduce SOV travel.

[50] http://www.wsdot.wa.gov/NR/rdonlyres/D108DA4F-7BC0-4F4F-A524-ECE2B2121612/0/ExecSummary.pdf

Since 1990, UW has been able to reduce its SOV commute percentage from 34% to 18%, with many travelers shifting to transit utilizing the U-PASS program. Ridesharing declined from 10% to 7% over the same period of time (perhaps related to the overall decline in driving), while walking and biking shares fluctuated slightly with modest overall growth. UW has set goals for further SOV reductions and a large shift from transit to walking, biking, and ridesharing. This is driven in-part by concerns that the transit subsidy provided via the U-PASS program has become so popular that it is unsustainable at current utilization rates. It also reflects UW's desire to better connect with the University District and to encourage campus community members who live there to use carbon neutral transportation options to help meet sustainability goals.

To address these goals, UW has recently helped bring a dozen Pronto Cycle Share[51] stations to the University District and is a partner in rebuilding the Burke-Gilman Trail through campus - the region's most significant multi-use commute trail which UW anticipates will soon be overwhelmed by growing demand. It is for these efforts and more that the League of American Bicyclists[52] awarded the University with a gold rating—making the UW one of only ten universities in the nation with this status.

UW's Current Transportation Programs

UW's Transportation Services office provides a wide array of benefits, subsidies, and programs to the UW campus community designed to incentivize people to choose options other than driving alone. The nationally-known U-PASS program is the cornerstone of the program serving both as a transit pass and membership card for other benefits, including:

- One-third parking discount for carpools of three or more, and free priority vanpool parking anywhere on campus.
- $80 monthly vanpool fare subsidy (per member).
- Carshare and bike share membership discounts.
- A night hours campus shuttle to encourage daytime walking and ridesharing

In addition, UW provides additional TDM programs which complement U-PASS:

- "Commute Concierge" personalized trip planning service
- Discounted occasional-use parking rates for employees.
- Free shuttles to affiliated medical centers.
- Extensive walking and biking amenities and infrastructure, including nearly 6,000 bicycle parking spaces, with over 50 percent covered and most within 200 feet of a building.
- Bicycle and walking events and campaigns including the annual Ride in the Rain bicycle commute competition that attracts over 1,000 people each year to ride through the month of November.
- Ridematching services through Zimride[53] and other platforms to connect carpoolers and vanpoolers.

[51] https://www.prontocycleshare.com/
[52] http://bikeleague.org/league-vocabulary/bicycle-friendly-university
[53] https://www.zimride.com/

Innovative Policies and Technologies

The U-PASS program gives every UW student a universal transit pass that provides unlimited fare-free trips on all regional public transportation bus, commuter rail, light rail, streetcar, and passenger-only ferry services. The U-PASS is integrated into the UW ID Card, the Husky Card (Figure 24), so every student has one with them at all times. UW students voted to make U-PASS membership automatically funded through a fee charged along with tuition; however a large portion of the costs is subsidized by the university. U-PASS members also receive discounts from local merchants and businesses, including carsharing providers Zipcar[54] and car2go[55], and Pronto[56] the Seattle area bike sharing system. UW employees are eligible to purchase a U-PASS membership at a subsidized rate.

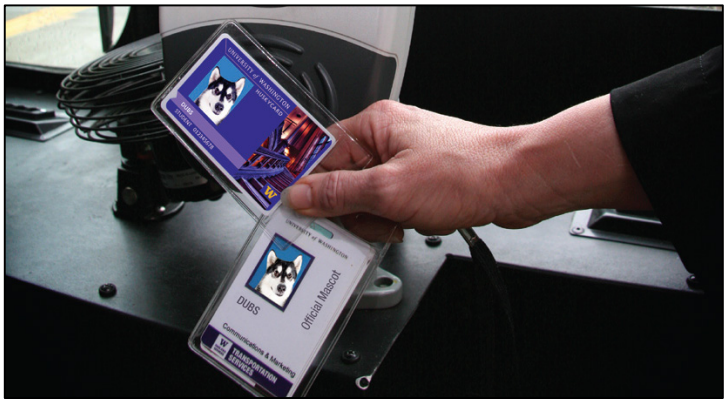


Figure 24: UW's Husky Card student ID with U-PASS integration
SOURCE: University of Washington

As of fall 2014, all UW students and employees can make use of a new Commute Concierge service. The program was launched in-part to respond to planned cuts in regional transit service. The Commute Concierge provides personalized help to commuters in considering multiple commute options, and makes it easier to choose alternatives to driving alone. It provides commuters with individualized assistance to cut through the complexity of commute options and offers a single point of contact for comprehensive transportation assistance. The program develops personalized commute plans based on the customer's starting and ending times and locations, provides customers with informational materials, and answers commuters' questions in person, over the phone, and via email.

Initial response to the Commute Concierge service was overwhelmingly positive, with the program helping 1,000 customers in its first six months. This may have been due in-part to UW's use of targeted marketing during the program's launch, which communicated planned transit service cuts to commuters based on their home zip code, and simultaneously provided information about other options that were most applicable to commuters living in that zip code. In this way, UW was able to provide more relevant information to individuals than if the same messages were sent to all commuters without regard for location. UW has employed targeted marketing in other communications activities as well, with similar success.

The Commute Concierge service is available to all UW affiliates, but outreach is particularly targeted towards new students and employees, and people who have had another life change that could impact their commute, such as a change in schedule or home location. The Commute Concierge is one of the

[54] http://www.zipcar.com/
[55] https://www.car2go.com/en/seattle/
[56] https://www.prontocycleshare.com/

strategies identified in UW's Climate Action Strategy for Transportation, which guides UW Transportation Services staff in making informed, tactical, timely decisions around effectively encouraging more commuters more of the time to choose lower-carbon modes.

UW also uses U-PASS program membership to support the delivery of incentives for carpoolers. In 2015 UW initiated a complete redesign of its carpool incentive programs. Under the new program, commuters will be encouraged to consider carpooling through increased marketing, direct assistance getting a carpool started, and a carpool challenge event with trial incentives for new carpools. The carpool challenge will track the trips of carpool teams with the opportunity for top performers to earn prizes and receive recognition. Under the new carpool incentive program, UW will focus incentives and discounts on people making the switch to carpooling. However, UW will continue to support existing carpoolers with ongoing staff engagement, random drawings for prizes, and priority parking spaces. Three-person or greater carpools will receive a one-third discount on the daily parking rate ($5.00 instead of $7.50), which if split between the carpoolers results in a 78 percent discount on a per-person basis ($1.67 instead of $7.50).

UW has experimented with innovative ways to use existing parking technology to provide discounted parking to unregistered, occasional carpoolers. One pilot allowed carpool members to swipe their Husky Cards for payment when entering a parking garage. If two different cards were swiped, the system would automatically apply the discounted carpool parking rate and split the costs between the two cards. UW staff expressed excitement about the potential for this type of system to provide incentives for occasional carpooling. However, due to a change in parking access and payment hardware, the pilot was discontinued. UW is currently exploring integrating this concept into the new system and expressed enthusiasm about the potential to restart the program if the new parking technology can be integrated with the Husky Card.

Because of its location near the tolled SR-520 Bridge across Lake Washington, the UW campus is well-positioned to make the most of ridesharing. As part of a bridge replacement project, HOV lanes for carpools of three or more occupants are being added to the bridge. However, UW Transportation Services staff have found that ridesharing suffers from some systemic barriers that have been difficult for the university to address. Because ridesharing options tend to be perceived as less flexible and reliable than transit, biking, or other alternatives, they have seen lower than desired adoption rates. Nevertheless, UW is hopeful that new advances in ridesharing technology may help address these barriers.

Some UW commuters participated in a Washington State DOT (WSDOT) pilot of the casual carpooling system Avego (now known as Carma) on the SR-520 corridor in 2011.[57] The system enables users to identify potential carpool partners on the go, without pre-arrangement, via smartphones. The system provides some pre-screening of both riders and drivers and a secure, digital method for automatically calculating and paying reimbursements from riders to drivers through the application. The platform

[57] http://www.wstc.wa.gov/meetings/agendasminutes/agendas/2011/May17-18/documents/20110518_BP8_Carpool.pdf

hopes to enable an expansion of casual carpooling beyond the few sites where it is commonly practiced in the U.S. - the San Francisco Bay Area, Washington, D.C., and Houston.

Through their participation in the pilot, UW Transportation Services staff saw that the Avego system struggled early on to achieve a critical mass of drivers to ensure that a suitable match would usually be available when a rider looked for one through the mobile app. This may have caused some riders to perceive the system as not reliable or flexible enough to be useful to them. This pilot later supplemented the pool of riders by providing dedicated drivers employed by Avego to pick up riders along the corridor, which improved participation. UW's experience in the pilot suggests that smartphone-enabled casual ridesharing has the potential to increase adoption rates, but only if a critical mass of riders can be established such that the service is very predictable and reliable. Another benefit of this type of technology is that it could provide UW with greater insight into the utilization of ridesharing options and the travel patterns of rideshare participants, something which its current ridematching service does not provide. As UW continues to grow, its traffic management agreement with the City of Seattle and its relationships with neighbors and businesses in the University District (Figure 25) have become more important.

UW is actively participating in a community planning process in the University District which seeks to shape a more vibrant, walkable neighborhood. One goal is to develop an environment which will encourage more campus users to walk and bike to campus. This effort is spurred in part by the planned opening of the new light rail station on the UW campus, which will also likely result in further redevelopment of the District. UW is also working with the U District Partnership business improvement area to develop a package of coordinated transportation services and infrastructure investments for those not affiliated with the University. These efforts are likely to continue to support UW's ridesharing programs and other TDM programs as the overall package of options continues to grow and diversify both on and off campus.

Figure 25: Ariel view of the UW campus and neighboring University District, with Downtown Seattle visible in the distance.
SOURCE: http://opb.washington.edu/content/west-15th-avenue-planning

Key Insights for Peers and Communities

UW's integrated approach to transportation services provides insights for peer universities working to reduce SOV travel to campus and for cities, regions, and States with similar trip reduction goals:

- **The convenience of the U-PASS all-in-one transit pass** automatically included in the Husky Card has dramatically increased transit usage.

- **Leveraging the U-PASS as a gateway to ridesharing subsides and other options** helps support both ridesharing and transit, which users can switch between based on daily schedules.

- **Casual carpooling technologies have the potential to help overcome the perception that ridesharing is less reliable and flexible** than transit or driving if adopted by drivers in sufficient numbers to ensure seamless reliability.

- **The relationship between the University and City is of paramount importance.** Coordination is essential to meeting both campus expansion needs and transportation management goals.

- **State and regional polices can be important support for local, institutional, and private-sector efforts** to manage SOV trips, even if they don't set higher targets.

Because the U-PASS is automatically integrated into every UW student's Husky Card, and because the card works on all of the Seattle metropolitan area's major transit systems, UW transit ridership has increased substantially, with a corresponding decrease in SOV travel. Metropolitan areas that have not yet developed a common transit fare card might look to UW's experience as a model. Furthermore, transit agencies might look to UW's success and seek to develop partnerships with large employers (e.g., hospital systems, public school districts, government agencies) to integrate fare card technology and transit subsidies into employer ID cards.

Similar to UW's success with leveraging the U-PASS brand to support ridesharing and other commute alternatives, other large employers could build their programs around an integrated fare card/ID card concept as well. Much like UW provides incentives for carpools and discounted carsharing and bike sharing memberships, employers might consider pairing subsidies and incentives with the card such as modest time off bonuses or recognition on the company bulletin board or website. The tracking functions of the card would enable employers to verify that employees meet incentive criteria and to learn more about their travel preferences and behaviors, which could help employers better plan their parking needs. MPOs, city governments, and State DOTs could play a convening role, or perhaps even a coordinating or administrative role if participation in the program were sufficiently widespread. However, implementation of this concept at a city or regional scale is likely to be much more complex than at UW, where all participants are affiliated with the University.

UW's experiences in the SR-520 casual carpooling pilot showed interesting potential for smartphone-enabled ridematching to help overcome some of the barriers to traditional ridesharing, most importantly by removing the need to arrange carpools in advance. Furthermore, UW transportation

services staff have expressed excitement that such a system could provide much improved data on the utilization rates and behaviors of rideshare users, which is currently not available. However, UW saw that the pilot suffered from a lack of reliability because it wasn't able to attract a sufficient number of drivers to ensure that seats would be available when riders were looking for them.

State DOTs and MPOs might consider partnering directly with universities, other large employers, and developers of dynamic casual carpooling applications to further explore the potential of this technology, and in particular to explore ways to overcome the initial lack of drivers as the program starts up. Agencies might also consider blending some of the aspects of established casual carpooling networks in the San Francisco Bay Area, Washington, D.C., and Houston, which often utilize public parking lots as established pick-up areas for those seeking rides.

UW transportation services staff consider the original 1983 agreement between UW and the City of Seattle to be the primary external motivation for UW's transportation services programs because the UW/Seattle agreement is more restrictive than CTR in the number of trips/VMT allowed, and because for UW to continue to grow it must maintain a productive relationship with the City and the University District. Given UW's experience, local governments which are homes to large campuses (e.g., university, hospital, employer HQ) may look to the UW/Seattle agreement as a model for how they can encourage campus managers or other significant public or private entities to adopt similar programs. MPOs and States might also consider promoting such agreements as tools for TDM at a regional or statewide scale.

State CTR legislation passed in 1991, which mandated that large employers reduce SOV commuting, and more recent statewide greenhouse gas emission reduction targets, also provide important support for UW's transportation policies. State greenhouse gas reduction targets appear to have had little direct influence on UW transportation programs because UW has set more ambitious greenhouse gas reduction goals than the State as a whole, which is common among institutions of higher education. However, the statewide focus on SOV trip and greenhouse gas emissions reductions provides an important supportive policy context which influences the behavior of city, regional, and State transportation agencies, the private sector, and individual residents in the State.

The success of the U-PASS and related programs demonstrates the potential for integrated and coordinated transportation services to effect long-term traveler behavior. By providing a suite of transportation services, polices, and incentives that build-on and support each other, UW has achieved a remarkably low SOV travel rate. The UW case shows the potential for new technologies to further enhance ridesharing and related policies as an increasing portion of the overall picture, and lead to a much more dynamic and less auto-dependent transportation environment. While they would be much more complex outside of a campus context, MPOs, States, and cities might look to the UW example as a demonstration of the potential for investments in new technologies and enhanced coordination to generate similar results at regional, statewide, or local scales.

For More Information

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Yale University
New Haven, Connecticut

Description of the University

Yale University is a private research university with roughly 12,000 undergraduate and graduate students. The majority of undergraduate students live in on-campus housing in the university's central campus in downtown New Haven, Connecticut (Table 11). The central campus is 260 acres and is flush against the grid of the City of New Haven (Figure 26). The university also has a research hospital and houses related activities on the other side of the highway from downtown New Haven.

Figure 26: Yale University Campus
SOURCE: Yale University

Table 11: Characteristics of Yale and New Haven Area Commuters

	Yale University	New Haven, CT Metropolitan Area
Population:	25,000 (students/faculty/staff)	860,000
% of Undergraduate Students Living On-Campus:	88%	n/a
Neighborhood/Regional Context:	Urban	Medium (500,000 – 1,000,000)
Public Transportation Context:	Commuter Rail, Local Bus, Express Bus, Campus Shuttle	Commuter Rail, Intercity Passenger Rail, Local Bus, Express Bus, Intercity Bus
SOV Commute Share:	38%	82%
Carpool/Vanpool Commute Share:	7%	9%
Public Transportation Commute Share:	22%	4%
Walk/Bike Commute Share:	32%	5%

SOURCES: Yale University, and U.S. Census Bureau; 2013 American Community Survey 1-Year Estimates (Table B08101)

Community Context

Yale's main campus is a dominant element of New Haven's historic downtown (Figure 27). The campus occupies the blocks on the west and north side of the New Haven Green. Commercial office buildings dominate the blocks east and south of the Green. After decades of economic difficulties in downtown New Haven, the central part of New Haven is experiencing a bit of a revival. There are many new retail establishments and restaurants that have opened up within the last ten or fifteen years. The eastern end of the downtown area also has a new full service grocery store that serves commuters to downtown and a growing residential community.

Figure 27: Downtown New Haven at Night
SOURCE: Yale University

New Haven has a population of roughly 130,000 people and is the center of a relatively dispersed metropolitan area of about 860,000 people. The metropolitan area, New Haven County, comprises the eastern-most portion of the consolidated metropolitan area of greater New York City. New Haven is a major transportation hub for the Northeast. The city is accessible by Metro North and Connecticut commuter rail and is a transfer point for Amtrak's Northeast Regional train that operates a high-frequency service between New York City, Providence, and Boston as well as service between New Haven, Hartford, Springfield, MA; and Vermont, which is soon to be supplemented by many more CT Rail trains. The city is also the site of the junction of I-95 and I-91.

Partially due to the extensive amount of automobile and truck traffic traversing the area, as well as its location downwind from heavy industry in the eastern Midwest and the New York City metropolitan area, New Haven has an ambient air quality problem with ozone and particulate matter pollution that frequently exceeds federal air quality standards.

University Transportation Issues and Trends

Most undergraduate students live on campus and do not have access to a private vehicle. Graduate students tend to cluster in off-campus houses and apartment buildings within two miles from campus. The faculty and staff at Yale are more dispersed and travel from as far as New York City and as near as the central New Haven neighborhood of East Rock.

The majority of Yale faculty, staff, and graduate students commute by modes other than driving alone at rates far exceeding the regional average, which is not surprising considering the dispersed suburban quality of New Haven County and Yale's location in the core of downtown New Haven. The Yale community, however, carpools less than the regional average, making up the substantial difference with higher rates of walking, bicycling and public transit use.

Yale is expanding and because its main campus is hemmed in by the historic core of the city, it is opening new satellite operations in other parts of the city (Figure 28). There is a large medical school south of downtown and a relatively new Yale West campus in the neighboring city of West Haven. These campuses are connected to the main campus by Yale Shuttle service.

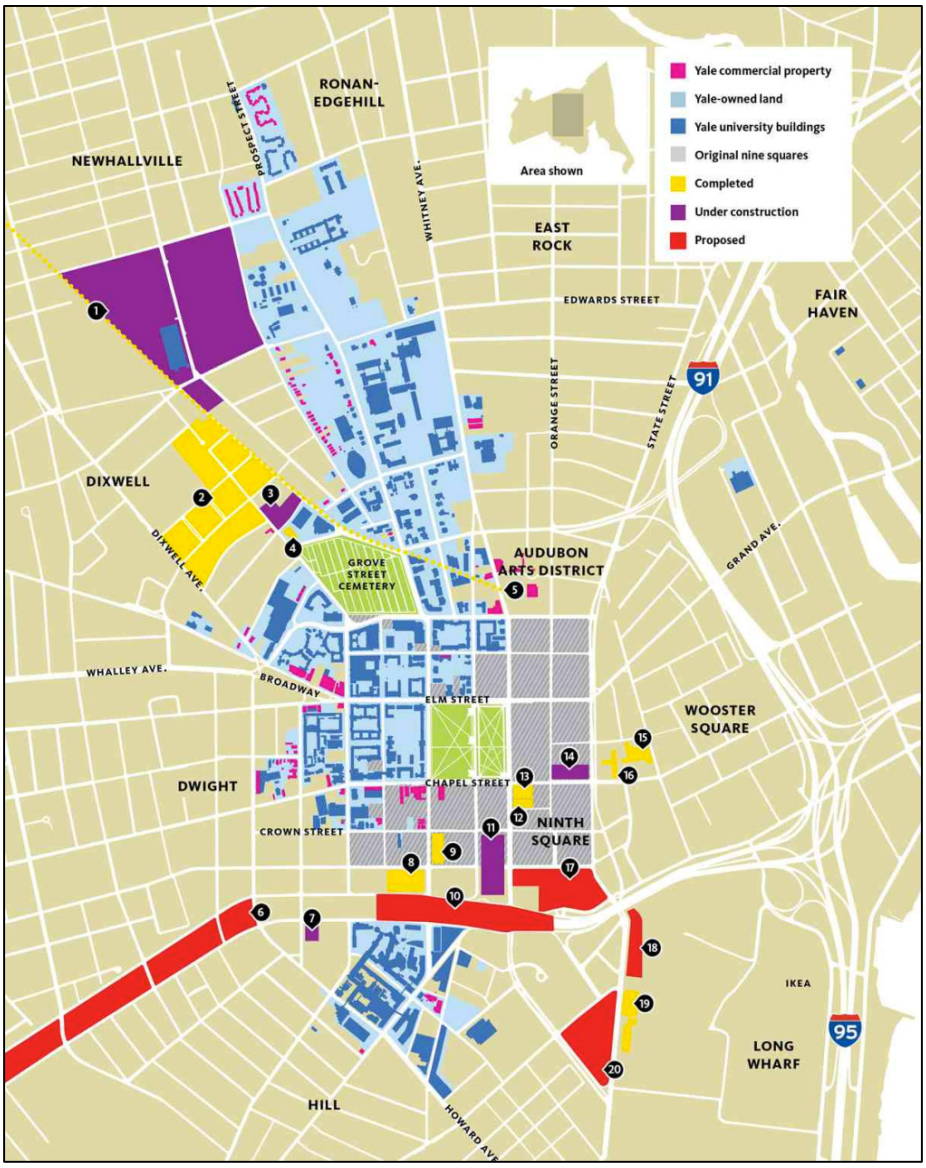

Figure 28: Yale University properties
SOURCE: [Yale Alumni Magazine]

Yale's Current Transportation Programs

Yale offers a ride matching service with NuRide[58], which offers participants various benefits in the form of consumer rewards like discounts at local restaurants, museums and shops. It also offers discounts for Peapod grocery delivery, which supports commuters who carpool or use transit and do not have a car available for grocery trips.

Yale offers a free campus shuttle that is geared towards students. The shuttle offers rides throughout the central campus and to the medical school as well as 20-minute headways to the new Yale West campus. The shuttle has been the most successful program of Yale's commuter services according to Yale University transportation administrators. Ridership on the shuttle continues to increase. Roughly one in five commuters to Yale do so using transit and two thirds of those commuters use the Yale shuttle instead of CT Transit buses or rail.

Yale's sustainable transportation program has pioneered the use of a new bike sharing technology with the Cambridge, Massachusetts based company Zagster[59] (Figure 29). Instead of a traditional kiosk-based bike share system where bicycles are docked at hubs throughout a service area, Yale's program includes the provision of 50 bicycles with electronic locks attached to them. Similar to a traditional car sharing system, this system requires that students and staff who rent a bicycle return it to its original location after they have used it and it charges them for the time that it was checked out. Currently, more than 600 members have signed up to use Yale's bike share service.

Figure 29: Yale bike share bikes
SOURCE: Yale University

Yale was one of the early partners of Zipcar[60] when it formed and provides Zipcars with free parking on campus. Zipcar has expanded its presence in New Haven since the service started at Yale, which has improved mobility options for the Yale and Downtown New Haven community.

[58] http://www.nuride.com
[59] http://zagster.com/
[60] http://www.zipcar.com/

Innovative Policies and Technologies

Yale's program was highly innovative in rolling out a new bike share model on campus. The more typical bike share program features docking stations that users can freely access but these docking stations are expensive and take up space. In addition to the expense of the docking stations, such programs require a lot of labor involved in re-balancing the system. Yale's system, developed by the company Zagster, does not have the one-way trip feature of station-based bike share programs but is less costly, more space efficient, and does not require the same degree of re-balancing as the docking-station model does.

The introduction and support of car sharing service on campus eight years ago had a positive effect on Yale's efforts to promote alternative mobility options. Because most of Yale's students live on or near campus, the combination of a carsharing program and free shuttle system has likely allowed the campus to retain its traditional pedestrian-oriented scale. When combined with the new bike sharing system, many households who live in and near the city center are able to meet their mobility needs without the need to own a private vehicle.

Yale has a very good relationship with the City of New Haven's Transportation, Traffic and Parking Department and has supported the City's work to implement more pedestrian- and bicycle-friendly streets. They partnered with the Director of the Transportation at the City to create a Complete Streets handbook, which influenced the development of a statewide Complete Streets policy. Bicycling plays a much greater role in mobility among Yale commuters so its expertise in this area is helpful to improve the conditions for bicycling in New Haven.

Yale offers "Commuter Counseling" through a simple web form that asks for a home address (or the closest street intersection to their home), address on campus, and time of day the commuter arrives and leaves. Transportation Options Program staff manually develop a comprehensive list of transportation options for each person requesting the service, including local train and bus routes, how to make connections between transit stops and ultimate destinations, information about pre-tax savings on their transit passes, and information about free monthly parking stays and guaranteed ride home programs offered to carpoolers and transit riders. The commuter is also guided to a website that allows them to post a carpool trip request, and has the best bicycling or walking route recommended for them as well.

Despite being in a walkable urban context, Yale is not much more successful at attracting campus users to carpooling programs than the metro area as a whole. This is likely due to the campus' location in a largely dispersed, auto-oriented regional transportation context. Advances in ride matching technologies may have helped slow declines in carpooling, but have not been sufficient to reverse the trend.

Key Insights for Peers and Communities

- **Smart-lock bike share technology** is an emerging option for smaller communities that wish to expand bicycling but for which traditional station-based bike share systems are not feasible.

- **Communities can support livability and help revitalize aging mixed-use neighborhoods by providing the suite of mobility options** that Yale has in its program. These options include bike share, carsharing, and free shuttle buses.

- **Universities can follow Yale's lead in becoming an active participant in shaping transportation planning and policy within their communities** because their needs are distinct from the larger population. Conversely, cities and MPOs would benefit considerably from soliciting the participation of universities in transportation and land use planning activities.

Yale is located in an historic city center that has recently experienced increased property values, an influx of retail and service businesses and growth in the residential population. Yale's programs, such as introducing carsharing and bike sharing to New Haven may have had a positive effect on the pedestrian culture of downtown New Haven and the growth of this urban community.

Many of Yale's commuter programs like facilitating car sharing, bicycling, and providing transit are not necessarily reducing the rate of commuters driving alone as these programs are primarily oriented towards undergraduates who live on campus or graduate students and staff who live proximate to campus. However, they have had the effect of increasing the mobility of car-free households who live in and near the city center and thus increase the quality of life of its residents. In this way, the programs have supported the desirable transformation of the downtown New Haven area into a 24-hour mixed-use and mixed-income community.

Cities and regions looking to support the growth of residential living and commercial activities in neighborhoods could apply some of Yale's strategies to improve mobility options for residents. In particular, Yale's experience with restricting parking, providing free shuttle service to important destinations and supporting innovations like car sharing and bike sharing together make it easy for residents to live without cars. By reducing the demand for car ownership, less space needs to be occupied by infrastructure to support cars such as parking garages and excess street lanes. Yale has not necessarily transformed its commuter profile towards non-auto modes because the suburban nature of the region limits transit's potential. However, its policies and programs in transportation have improved the mobility options of residents and workers in downtown New Haven and increased its livability.

There is a risk in being an early adopter of new technology. The bike share program was launched in 2013 and hit several rough patches in its initial implementation. The program has successfully adjusted to these growing pains in its first two years of operation. Yale is to be commended for launching a new business model for bike share that is more feasible for communities of this size, however similar areas that wish to try new models may want to follow in the footsteps of more developed models or be ready for hiccups in the implementation of a new service like this. Despite initial startup issues, Yale's program continues to grow and prosper. As the bike share industry matures, more companies besides Zagster,

including Social Bicycles (SoBi)[61], Republic Bike[62], On BikeShare[63], Gotcha[64], A2B Bikeshare[65], as well as Skylock[66], Bitlock[67], and Lock8[68] are entering into the business. These companies all have different aspects and approaches but all use the smart lock technology that enables this innovative lower-cost model of bike sharing. These models may provide a more efficient model for smaller communities or business districts.

Yale's program provides a useful example for smaller cities looking to improve travel options for residents and commuters using new technology, regions and cities looking to revitalize downtown areas and other aging activity centers, and university participation in local and regional planning. Each of these components of Yale's program has contributed to success at limiting driving to campus and improving the livability of Yale's surrounding community. No one strategy alone can account for these successes, but packaged together, Yale's programs have allowed Yale and New Haven to thrive.

For More Information

Yale University Office of Transportation Options
http://to.yale.edu/contact-us

[61] http://socialbicycles.com/
[62] http://www.republicbike.com/
[63] http://www.onbikeshare.com/
[64] http://www.thegotchagroup.com/#!bike/c12py
[65] http://a2bbikeshare.com/
[66] http://skylock.cc/
[67] http://www.bitlock.co/bikeshare.html
[68] http://lock8.me/

Appendix A: Acknowledgements

The Federal Highway Administration (FHWA) would like to thank the transportation staff of the universities featured in this whitepaper, who provided valuable information and insights into their programs, and who reviewed drafts of the case studies. The Association for Commuter Transportation (ACT) was also instrumental in helping the project team to review the research concept and identify potential case study candidates and university contacts. However, the contents of the report represent the views of the authors alone, and are not the responsibility of the U.S. Department of Transportation or FHWA.

The authors wish to thank Robin Smith, Egan Smith, and Lorrie Lau, the FHWA project managers, for their guidance and support in developing this white paper. The team also thanks the reviewers at FHWA Headquarters and Resource Center offices for their time and expertise in reviewing the document.