Commuting Behavior and Transportation Preferences of the CSUN Community

February 24, 2016
EXECUTIVE SUMMARY

In 2010 California State University, Northridge (CSUN) conducted its first complete survey of the commuting habits of its staff, faculty and students. Here we report on the results of our second survey conducted five years later and administered online between January 26 and February 28, 2015. The survey was distributed to 11,000 randomly selected members of the CSUN community (10,000 students and 1,000 faculty and staff), and garnered a 14.5% response rate (1,596 respondents). Based on these numbers, the margin of error in the survey results is: +/-2.5% for the total sample, +/- 2.8% for student data, and +/- 5.1% for faculty/staff at the 95% confidence level.

On average the campus community travels an average of 15.5 miles each way to CSUN, with students coming from an average distance of 15.0 miles, staff closer at 12.2 miles and faculty travelling quite a bit further at 20.4 miles. Survey results indicate that students, staff and faculty come to campus an average of 3.8, 4.9 and 3.1 days a week respectively. Thus, although the daily footprint of faculty is highest based on the distance they travel, this is offset by the fewer number of trips they make.

All groups continue to use private automobiles as the primary mode choice, but there are signs of improvement in 2015 over 2010. In 2015, 59% of students commuted via single occupancy vehicle (SOV) compared to 72% in 2010. This is a substantial improvement, and significantly greater than the sampling error. For faculty and staff results show little change. Staff SOV use improved slightly from 75% in 2010 to 73% in 2015, but faculty SOV use increased over the past five years from 87% to 90%. These faculty and staff changes are not statistically significant.

Since 2010 CSUN has incentivized alternative modes of transportation through a number of measures including construction of a transit station to bring buses to campus, enhanced bicycling infrastructure including new bike lines and improved bicycle parking facilities, and subsidized vanpool and public transit passes. In 2015 10.4% of students used some form of public transit, up from 8.7% in 2010. However faculty and staff showed a slight decrease in that figure from 7.9% in 2010 to 4.5% in 2015. Bicycling among students increased from 3.4% in 2010 to 4.2% in 2015, but fell from 2.8% in 2010 to 1.7% in 2015 for faculty and staff. Walking became more popular with the campus community as a whole. For students, it was up from 6.9% in 2010 to 12.7 % in 2015, and for faculty/staff the proportion walking increased from 2.2% in 2010 to 5.7% in 2015. Overall students have moved to more sustainable transport over the past five years, with 30% now travelling by means other than a car, but only 17% of staff and 6% of faculty use an alternative.

There is good news with regard to the environmental footprint of CSUN commuting. The annual per capita carbon footprint of all three sectors of the commuting community have decreased - students from 1.00 tonnes CO₂ in 2010 to 0.99 in 2015, faculty from 1.76 tonnes in 2010 to 1.17 tonnes in 2015 and staff from 2.08 tonnes in 2010 to 1.89 in 2015. However, because of campus growth the overall footprint has shown a slight increase from 42,263 tonnes in 2010 to 44,519 tonnes in 2015. Thus a 10% growth in campus population over the past five years has resulted in a 5% increase in emissions.
Although emissions have risen more slowly than the campus has grown, it continues to be CSUN's goal to reduce the total. The university will continue to promote alternative means of commuting, encourage a mode shift away from single vehicle occupancy, and provide incentives to those using mass transit, and higher fuel efficient and electric vehicles as discussed in our 2016 Climate Action Plan.

Preliminary data analysis was carried out by students in URBS 480: Urban Transportation Planning in Spring 2015 under the supervision of Dr. Mintesnot Woldeamanuel. This report was prepared by:

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INTRODUCTION

Automobile travel is credited as the major contributor of greenhouse gas (GHG) emissions, accounting for about 28% of GHG emissions in the United States and 36% in California (Rodier, 2009). The State of California has been a leader in climate change legislation with the passage of the Global Warming Solutions Act of 2006, AB 32, which sets GHG reduction targets to 1990 levels by the year 2020. Reducing per capita Vehicle Miles Traveled (VMT) is one of the most effective methods for reducing GHG emissions. The relationship between GHG and per capita VMT has prompted further legislative actions and policies in California, such as SB 375, the Sustainable Communities and Climate Protection Act of 2008, which seek to reduce per capita VMT through sustainable development strategies at the regional planning level. Yet, the lack of adequate public transport in the Los Angeles region and the predominance of motor vehicles as the primary means of commuting contribute greatly to carbon dioxide emissions and air pollution in the region. California State University, Northridge (CSUN), being a large urban school in the region is confronted with these challenges. CSUN employs about 4,000 faculty and staff and has a student enrollment of close to 40,000, the majority of whom commute to campus. To understand the transportation-related carbon footprint of the CSUN campus, the first survey was conducted in spring 2010. Based on the feedback from the survey results, CSUN implemented several infrastructure improvements to curb the high dependency on automobile use. Those improvements include extension of bike lanes, building additional on-campus student housing units, carpool and rideshare programs, electric car charging stations and an on-campus transit center. To understand the effects of those transportation and housing initiatives and to re-assess the transportation footprint, a second survey was conducted in spring 2015 and distributed to a random sample of faculty, staff, and students. The survey was administered online between January 26 and February 28, 2015, and distributed to 11,000 randomly selected members of the CSUN community (10,000 students and 1,000 faculty and staff). There was a 14.5% response rate with 1,596 respondents completing the survey. The survey includes...
information on commuting distance, mode choice, transportation preferences and challenges. The purpose of the survey is to understand the carbon footprint of current commuting, to examine more sustainable options for the future, and to further study CSUN commuting patterns. The survey results are compared with the findings of the spring 2010 survey. CSUN made several changes to transportation infrastructure and extended transportation options between the 2010 and 2015 survey periods, therefore, a comparison of the two surveys examines their effect in encouraging modal shift for trips to and from campus. The surveys also help the university to craft policies that encourage commuters to use more sustainable transportation options in and around campus.

Figure 1 shows the breakdown of respondents by type. Based on these numbers, the margin of error in the survey results is: +/-2.5% for the total sample, +/- 2.8% for student data, and +/-5.1% for faculty/staff at the 95% confidence level.

COMMUTER BEHAVIOR AND TRANSPORTATION PREFERENCE

Commuting distance

Survey recipients were asked one-way travel distance from home to the CSUN campus. This is portrayed in Figure 2 in increments of 5 miles up to 40+ miles,
with individuals beyond the 40 miles being grouped together. The results show that the largest number of respondents indicated that they live within 5 miles of the CSUN campus, with the percentages steadily decreasing for each increment until 40+ miles, where numbers increase. The average one way distance is 15.5 miles for the overall campus community whereas it is 15.0 miles, 12.2 miles and 20.3 miles for students, staff and faculty respectively (this is calculated after removing outliers).

The number of days in a week that individuals typically come to campus was assessed, with Figure 3 showing that students typically come four days (29%), most staff come five days (83%), and faculty mostly come three days (26%). Overall CSUN students, staff and faculty come to campus an average of 3.8, 4.9 and 3.1 days a week respectively. This information is relevant to computing the per capita CO₂ emissions.

**Mode choice**

As displayed in Figure 4, data on primary mode of transportation were gathered from the 2015 survey and compared with data from the 2010 survey, with respondents choosing from a list of modes they generally take to campus. Just as in 2010, results for all groups indicate that the private automobile is still the primary mode choice, with all other options lagging behind. Even so, there are signs of improvement. In 2015, 59% of students commuted via single occupancy vehicle (SOV) whereas in 2010, 72% of students used this mode,
marking a substantial reduction. And while a smaller percentage of students appear to carpool in 2015 (~6% vs. ~3%), a higher percentage use other modes such as bicycles, the CSUN housing tram, and especially walking. For both students and staff, the biggest change since 2010 is in the percentage of people walking to campus. For faculty, the only noticeable improvements are in the percentage who are either dropped off or use a bicycle; usage of all other alternative modes including vanpooling has gone down, and car usage has gone up. (It should be noted that with the small percentages in these alternative categories for faculty, these changes are not statistically significant.)

Yet, while there is no improvement in SOV use, it is worth noting the significance of the shift in student use. By far, students make up the bulk of campus population; over 40,000 students are enrolled in comparison to 4,000 combined staff and faculty, so changes in student behavior have a much bigger impact than changes in that of employees.

Of the respondents who use ridesharing as their primary mode, Figure 5 shows that sharing with one other person is most common for all demographic groups (students, faculty and staff). Out of the three demographics, staff are the ones most likely to share a ride with multiple others.

Figure 6 shows where drivers choose to park their vehicles. For each demographic, the preferred location is in one of the CSUN lots with an annual pass. The annual pass means not having to spend time using a pay station each visit, and is the most practical way for those coming to campus frequently. Additionally, CSUN lots are on campus and are thereby closer to classrooms and offices than a parking spot elsewhere.

To explore whether the provision of a local shuttle service is a feasible strategy in reducing SOV commuting, a question was posed to investigate potential interest if CSUN were to provide a shuttle service that circulated within a 3 mile radius of campus. Figure 7 shows results from those individuals who indicated that they lived within a 3 mile radius of campus. More than half of students indicated that they would likely utilize such a service, as did faculty, although faculty responses are too few to be significant. Most staff, on the other hand, indicated that they would be unlikely to use such a service. This might be due to work schedule concerns.

**Figure 8. Electric vehicle ownership (N=978)**

**Figure 9. Charging EV on campus (N=89)**
Electric vehicle

Questions regarding electric vehicles (EVs) were also asked. Figure 8 shows the number of people who own or lease one currently; 80 out of 978 responses were positive (8.2%), much higher than the national average of 2.5% of new car sales during 2014 (Sierzchula, 2015). The results also indicate that at 8%, students own/lease the highest proportion of EVs, followed by staff at 7% and then faculty at 6%, though the differences in proportion between these groups is not significant. We also asked whether or not users charged their EVs on campus, to which an aggregate of 90% of respondents said that they do not. More faculty charge their EV on campus compared to students and staff (Figure 9).

Factors Determining Mode Choice and Preference

The next set of questions in the survey was designed to find out what kinds of changes would be necessary to convert people’s mode of commuting to a more sustainable one. Individuals were polled on factors which might enhance the appeal of public transit, carpooling, and bicycling. CSUN’s student body indicated (Figure 10) that they would very likely take public transit if they only needed one bus to get to the campus and if the bus route took less time. Having to take more than one bus complicates and lengthens travel and is also more expensive, making such a sentiment understandable. Staff however were more concerned with easy access and multiple transfers, while faculty desired transit scheduling more in line with their personal scheduling. Possible explanations for these answers are that for staff members there is a need to be on campus early, meaning that travel time has to be shorter, whereas faculty are likely to have schedules that require them to arrive and leave campus at odd hours during the day, meaning that transit scheduling would need to be more accommodat-
ing for them. Clearly the most important factors driving the use of public transit are convenience rather than cost or comfort.

When it comes to increasing the likeliness of the campus body using carpool services (Figure 11), faculty are only likely to participate if they can find close-by commuters with similar schedules. Students and staff however, indicate that other factors also play a role, most importantly, an incentive of preferred or discounted parking. Students are also concerned about getting to know the other rider(s).

The last of the questions concerned use of bicycles (Figure 12). Students indicated that improved parking (covered parking and more parking) together with maintenance facilities were the most important factors driving bicycle use. The parking question perhaps relates to concerns over bike theft, with the perception being that covered parking decreases the likeliness. Staff were mostly concerned over shower/changing facilities. All groups desired to see improved bike routes off campus, which would facilitate easier and safer travel to and from campus. None of the groups would be influenced by offering more bike classes, and neither faculty nor staff would be strongly influenced by more bike lanes or bike parking on campus.

Accompanying each of these questions was a separate short-answer question directed at those individuals who indicated that they would not use public transit, carpool, or bicycle under any circumstances. Within the abundance of open ended responses provided for each question, there were 4 common themes: Ownership, Safety, Distance, and Dependency. In terms of ownership, people either owned or did not own a car or a bike. For those who owned a car, their reason for not wanting to cycle or use public transit came down to just that; if they own a car, why use anything else? Where carpooling was concerned, if they don’t own a car, then they obviously cannot provide a carpooling service, but even if they do own one, there is a reluctance to share that car with someone unknown. For bicycling, if they do not own a bicycle, then they cannot cycle to school no matter what provisions are added.

In terms of safety, some people indicated for public transit and carpooling that they wouldn’t feel safe travelling with strangers, and for cycling people wrote that they did not feel safe when travelling alongside car traffic. Distance was a matter of either living too close to campus in the case of public transit, or too far from campus in the case of bicycling. The final category of responses, dependency, relates to the fact that respondents had someone depending on them, or were dependent on someone else to get to campus. In these cases none of the alternative modes were deemed feasible; responses typically centered on employees or students who are parents and need to drop off children or pick them up from school.

Figure 13 shows results from a question concerning how respondents choose their method of travel. All groups indicate that travel time and convenience/flexibility are the greatest factors in selecting a travel method. This serves well to explain why the private automobile continues to be a dominant force in commuting. Interestingly enough however, cars are not the safest mode of transport, nor are they the cheapest or least polluter. Yet as shown in Figure 13, people are willing to ignore such concerns in exchange for the ability to get where they need to be when they want.

Spatial Analysis

Using a Geospatial Information System, the commuting locations were plotted from the street intersection data provided. Of all of the survey responses, 1,165
Figure 14a. Distribution of CSUN students by census tract
Figure 14b. Distribution of CSUN staff by census tract
Figure 14c. Distribution of CSUN faculty by census tract
Figure 15. Spatial distribution of all survey respondents by zip code
Figure 16. Respondents’ address (closest major intersection)
of the street intersections where students, staff, and faculty come from were able to be mapped through geocoding. Additionally, the zip codes provided helped locate particular intersections and were employed in density analysis. A choropleth map was created to allow for visual analysis of the density patterns of students, staff and faculty locations within the CSUN area. Five mile buffer rings were added to provide a better visual picture of distances covered. Although the spatial analysis is based on major intersection and zip code information as provided by survey respondents, a census tract level analysis is included to provide more detail on the locations where CSUN students, staff and faculty commute from (Figure 14: Distribution of CSUN students, staff, and faculty completing the survey).

Similar to Figure 14, Figure 15 shows the density map of survey respondents but based on zip code rather than census tract. Of the individuals who responded to the survey, most come from a location nearby the CSUN campus, likely, students living in dorms and nearby apartment complexes. Interestingly, a significant portion of respondents come from beyond the twenty five mile radius, coming from areas such as Palmdale/Lancaster, Bakersfield, Santa Barbara county, and as far south as Mission Viejo. Similar to Figure 15, Figure 16 is a dot density map of the addresses provided by survey respondents. Broken down by demographic, staff members are the most concentrated around campus, with the majority residing within 10 miles. Students and faculty are scattered throughout the region, with large portions of their overall populations living within 10 miles from campus (53% students, 59% staff and 38% faculty lives within 10 miles of campus).

Distribution of carpool users

Regarding the carpool/ride-share user distribution in Figure 17, there is clear indication that those who travel from more than 15 miles away are more likely to form a carpool, likely utilizing student-organized rideshares. A significant proportion of those living in the Antelope Valley also carpool. Closer to campus fewer people carpool, though other methods of transport such as bus, bicycle, or walking are likely more attractive.

Distribution of car users

Figure 18 shows the percentage of those individuals from any given starting location that use their car as a primary means of transportation. For every region from which people commute to campus, driving a car is the most popular transportation option. For most zip codes, 70-100% of commuters use a car. The only exception might be those living very close to campus. 37% of respondents stated that they drive from farther than 15-20 miles away, contributing to the characterization of CSUN as a commuter campus. Some individuals indicated that they come from as far as 80 miles away, meaning that their drive could be as much as two hours.

Distribution of bus users

When it comes to respondents who use Metro bus services, Figure 19 shows that areas which exhibit high population densities are more likely to exhibit high usage —something attributable to the likelihood of increased availability of bus service in those areas. Some parts of the areas close to CSUN as well as in downtown Los Angeles have higher bus user populations. It is also worth noting here that higher percentages of bus users stem from the downtown LA area than any other area.

Distribution of train users

Figure 20 charts the responses of those who indicated that they travel to campus by rail. Similar to the Metro bus users, and for similar reasoning, those who use rail are from high-density areas like downtown LA and areas where there is direct route between their residence and CSUN. If we look at the example of Lancaster, we can see that there are 16-20 respondents in that zip code that use the train, as there is a Metrolink line starting from Lancaster and going through the San Fernando Valley.

TRANSPORTATION CARBON FOOTPRINT

Analyzing the carbon footprint quantifies one of the environmental effects of the transportation mode choices made by the CSUN population, specifically the CO2 emissions that these choices generate. Emissions from transportation are significant in the increase of greenhouse gases
Figure 17. Percentage of campus commuters within each zip code using rideshare as primary means of transport.
Figure 18. Percentage of campus commuters within each zip code using SOV as primary means of transport.
Figure 19. Percentage of campus commuters within each zip code using bus as primary means of transport
Figure 20. Percentage of train users in a zip code
leading to climate change, poor air quality, and accompanying health issues.

California State University, Northridge is an institution where most students live off campus, so carbon emissions from commuting are of particular concern. To calculate energy used and accompanying CO₂ emissions, the following components of the survey were utilized: number of per-week trips to CSUN; percent of students, faculty, and staff traveling by each transportation mode; miles per gallon (mpg) of vehicle and distance in miles to CSUN. Responses to car make, model, and year were used to determine the average miles per gallon, and to calculate energy consumption and CO₂ emissions.

Vehicle fuel economies were calculated using fueleconomy.gov, an EPA (Environmental Protection Agency) website which provides mpg data based on the make and the model of the car. The average of 4 cylinder and 6 cylinder mpg values were used where necessary since the survey did not ask respondents for this data. After generating accurate mpg values, data were cleaned by removing incomplete and unrealistic responses. This reduced the number of valid responses 941. From these data averages for mpg, number of trips per week to CSUN, and approximate miles (one way) were established. Using numbers of student, faculty, and staff responding, percentages for each mode of transportation were calculated, with the modes studied being car, carpool, bus, train, and motorcycle. Average mpg for car, carpool, bus, train, and motorcycle were used to determine...
gasoline, energy consumption and CO₂ emissions, and verified using truecostblog.com (APPENDIX 2).

Gasoline, energy consumption, and CO₂ emissions were calculated for the entire campus population of students, faculty and staff by extrapolation of the survey data. Total fuel consumed weekly was calculated based on total numbers of CSUN students, staff, or faculty, percent (of students) living off campus, average commute days per week for each population group, average distance in miles (multiplied by 2 for total daily distance), percent of each population group commuting by a given travel mode, and average mpg of vehicle or transport mode.

1. Gallons of gasoline = Number of CSUN [Student/Staff/Faculty] * Percent living off campus * Average number of commute days * Average distance (one way) * 2 * Percent of [Student/Staff/Faculty] commuting by (Travel Mode) / average mpg of (Travel Mode).

2. Energy consumption = Gallons of gasoline x Energy conversion factor (kWh/gallon)

3. CO₂ emissions = Gallons of gasoline x CO₂ conversion factor (lbs CO₂/gallon)

The results from these equations were used to determine CO₂ emissions and energy consumption for each subject group. An energy conversion factor of 36.34 kWh per gallon of gasoline was used (http://alternativefuels.about.com/od/resources/a/gge.htm). The energy conversion factor for bus and train was 40.74 kWh/gallon due to the use of diesel. The CO₂ conversion factors used were 19.64 lb of CO₂ per gallon of gasoline, 22.2 lb of CO₂ per gallon of diesel, and 0.379 lb CO₂ per passenger mile for train travel (epa.gov). Weekly findings were then converted into annual results by multiplying the results by 30 weeks (a typical school year) for students and faculty, and 50 weeks for staff.

There was a particular interest in the comparison of energy consumed and CO₂ emissions with the data from the survey conducted in 2010. The total annual energy consumption for 2015 was 181 GWh, while 2010 yielded a total of 175 GWh. According to the 2010 survey, the calculated annual CO₂ was 42,260 tonnes whereas in 2015 it is 44,519 tonnes. The result shows an increase of 5.5% of carbon emissions, and a 3.4% increase in energy consumption over a five year period. This can
be attributed to the increase in student enrollment, as 2010 reported a total of 35,000 students, while 2015 reports about 40,000 students, an increase of 5,000 students (a 14% increase).

Where per capita energy consumption and CO$_2$ emissions are concerned, Figures 22-24 shows that faculty members have relatively higher values. This is due to the fact that a high percentage of faculty drive alone, and as indicated in Figure 2, drive further on average.

**CONCLUSIONS AND RECOMMENDATIONS**

The survey results show that in the last five years there is a major modal shift by students from driving alone to walking. This might be attributed to student housing and more students living around campus. Faculty and staff also a variety of commuting modes. Twenty-five percent of survey respondents in the 2015 data use their primary mode of transportation less than 75% of the time. This shows that multi-modal travel is important, and that by focusing future efforts on increasing the viability of alternative modes of transportation, car usage would decrease overall.

It is important to note that CSUN’s Electric Vehicle use is higher than the national average. Although this is very encouraging, users would like to see more charging stations, and strategic location of them. These strategies would likely increase the use of environmentally friendly vehicles.

This study also shows that there is an increase in CO$_2$ emissions in 2015 compared to the 2010 data. Although this is attributed to the increase in student population, faculty and staff, efforts still have to be made to curb the transportation-related carbon footprint of CSUN. The CSUN Climate Action Plan, which is being prepared based on the data from the 2010 and 2015 surveys, lists detailed strategies to achieve the goal of reducing or eliminating the carbon impact of the transportation sector.
APPENDIX I: CSUN COMMUTING SURVEY 2015
Questionnaire and Results

Date Survey Conducted: January 26—February 28, 2015
Total Sample: 1603
Students: 1235
Faculty and Staff: 368
Margin of Error for total sample: +/-2.25% at 95% Confidence Level
Margin of Error for Students: +/- 2.63% at 95% Confidence Level
Faculty and Staff: +/- 5.02% at 95% Confidence Level

1. Which of the following best describes you?
   a. Student 77%
   b. Staff 14%
   c. Faculty 9%

2. Do you live in CSUN student housing or off campus this semester?
   a. Off-campus 93%
   b. CSUN student housing 7%

3. If you live off-campus, do you commute from:
   a. Parents/own home (“permanent home”) 63%
   b. Rental apartment/home (“temporary” home while at CSUN) 37%

4. Please enter the city, zip code and major intersection (two street names, eg. Nordhoff Street and Reseda Boulevard) from which you typically commute to the CSUN campus this semester (open ended).

5. Approximately how many miles is it from your home to the CSUN campus? (Give one-way distance)
   Average = 15.54

6. In a typical week this semester, how many days do you come to the CSUN campus?
   a. 0 days 2%
   b. 1 day 4%
   c. 2 days 12%
   d. 3 days 19%
   e. 4 days 24%
   f. 5 days 32%
   g. 6 days 6%
   h. 7 days 2%

7. In a typical day this semester, at what time do you arrive at CSUN (open ended)?

8. What is the primary mode of transportation that you use most often to come to the CSUN campus this semester?
   a. Amtrak, Metrolink Train, or Metro Rail 2%
   b. Antelope Valley Transit Authority Bus 1%
   c. Bicycle 4%
   d. Carpool 4%
   e. CSUN Housing Tram 2%
   f. Drive alone 64%
   g. Metro Bus 6%
   h. Motorcycle, motorized scooter, or moped 0%
   i. Skateboard, scooter, or rollerblade 2%
   j. Vanpool 0%
   k. Walk 11%
   l. Someone drops me off 4%
   m. Other 0%

9. Please list the bus number(s) that you take to get to CSUN (open ended).

10. If you use public transit, how do you usually travel between the bus stop or train station and the CSUN campus?
   a. Bicycle 2%
   b. Bus 15%
   c. CSUN Shuttle 9%
   d. Someone drives me 2%
   e. Walk 65%
   f. I don’t use the bus/train (public transit) to come to campus 7%

11. If and when you come to campus in a carpool or rideshare, how many people usually occupy the vehicle, including yourself?
11. How many people does your carpool/rideshare group consist of?
   a. 2 people 44%
   b. 3 people 8%
   c. 4 people 3%
   d. 5 or more 2%
   e. I don’t carpool/rideshare to campus 44%

12. If and when you come to campus in a carpool or rideshare, are you ever the driver of the vehicle?
   a. Yes 32%
   b. No 68%

13. Are you a member of the CSUN Vanpool Program or another vanpool program?
   a. I am not a Vanpool member 93%
   b. CSUN Vanpool Program 7%
   c. Other vanpool program 0%

14. When you drive your vehicle to campus this semester where do you usually park?
   a. CSUN parking lot or structure with a semester or annual parking permit 77%
   b. CSUN parking lot or structure with a daily permit 9%
   c. Off campus 14%

15. How many miles per gallon (MPG) does your vehicle typically average (city and highway combined)? (refer http://www.fueleconomy.gov/feg/make.shtml.) If you don’t know, please answer the next question.
   Average Miles per gallon (MPG) = 25.85 (Calculated based on EPA fuel economy data)

16. What is the make, the model and the year of the vehicle you drive to campus most often?
   a. Make of the vehicle (eg. Toyota) 100%
   b. Model of the vehicle (eg. Corolla) 98%
   c. Year of the vehicle (eg. 2000) 99%

17. Do you own/lease an electric vehicle?
   a. Yes 7%
   b. No 93%

18. Do you ever charge your electric car while on campus?

19. On a typical day, when you need to charge your vehicle, how often you find a charging station available?
   a. Rarely 36%
   b. Not often 46%
   c. Often 0%
   d. Very often 18%

20. How satisfied are you with the location of the charging station (relative to where your office or classroom is located)?
   a. Very Unsatisfied 23%
   b. Somewhat Unsatisfied 8%
   c. Somewhat Satisfied 23%
   d. Very Satisfied 46%

21. What are your reasons for not charging while on campus? (open ended)

22. What percentage of the days you come to campus this semester do you use your primary mode of transportation (the mode of transportation you identified earlier as a primary mode)?
   a. 100% of the days 75%
   b. 75 to 99% 18%
   c. 50 to 74% 5%
   d. less than 50% 2%

23. If CSUN provided a shuttle service within 3 mile radius from campus (that circulates Devonshire Street, White Oak Avenue, Parthenia Street and Wilbur Avenue), how likely would you use it to get to campus?
   a. Very Unlikely 47%
   b. Somewhat unlikely 16%
   c. Somewhat likely 21%
   d. Very Likely 17%

24. Would you be willing to take public transit to campus at least one day a week this semester or in a future semester?
   a. Yes, under the right conditions 58%
b. No, not under any circumstances 33%
c. I already use the bus or train to campus at least one day a week 10%

25. Which of the following would increase the likelihood that you would take public transit to campus at least one day a week?

a. I had easy access to a bus stop or train station from my commute address.
   - Very Unlikely 9%
   - Somewhat Unlikely 9%
   - Somewhat Likely 38%
   - Very Likely 44%

b. The bus or train schedule worked better with my schedule.
   - Very Unlikely 11%
   - Somewhat Unlikely 8%
   - Somewhat Likely 33%
   - Very Likely 48%

c. The bus or train routes took less time to arrive on campus.
   - Very Unlikely 11%
   - Somewhat Unlikely 8%
   - Somewhat Likely 29%
   - Very Likely 53%

d. It required only one bus to get to campus.
   - Very Unlikely 12%
   - Somewhat Unlikely 6%
   - Somewhat Likely 25%
   - Very Likely 57%

e. There were a bus stop on campus for my bus line.
   - Very Unlikely 11%
   - Somewhat Unlikely 10%
   - Somewhat Likely 30%
   - Very Likely 50%

f. Public transit cost less.
   - Very Unlikely 12%
   - Somewhat Unlikely 14%
   - Somewhat Likely 29%

g. Public transit was safer and/or more comfortable.
   - Very Unlikely 11%
   - Somewhat Unlikely 14%
   - Somewhat Likely 30%
   - Very Likely 44%

26. Please briefly tell us why you would not take public transit to campus under any circumstances (open ended).

27. Would you be willing to carpool to campus at least one day a week this semester or in a future semester?

a. Yes, under the right conditions 68%
b. No, not under any circumstances 24%
c. I already carpool at least one day a week 8%

28. Which of the following would increase the likelihood that you would carpool to campus at least one day a week?

a. I could find others to carpool with who have schedules similar to mine.
   - Very Unlikely 5%
   - Somewhat Unlikely 6%
   - Somewhat Likely 37%
   - Very Likely 52%

b. I was guaranteed a ride home in an emergency.
   - Very Unlikely 6%
   - Somewhat Unlikely 10%
   - Somewhat Likely 33%
   - Very Likely 52%

c. I could find others who have similar driving habits and preferences (music, radio, smoking, speed, etc).
   - Very Unlikely 11%
   - Somewhat Unlikely 17%
   - Somewhat Likely 40%
   - Very Likely 32%
d. I could find others who commute from close to my address.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>5%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>8%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>33%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>55%</td>
</tr>
</tbody>
</table>

e. I could get to know the person/people beforehand.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>7%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>9%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>39%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>46%</td>
</tr>
</tbody>
</table>

f. CSUN offered preferred or discounted parking for carpools.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>5%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>8%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>28%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>59%</td>
</tr>
</tbody>
</table>

29. Please briefly tell us why you would not carpool to campus under any circumstances (Open ended).

30. Would you be willing to bicycle to campus at least one day a week this semester or in a future semester?

a. Yes, under the right conditions 33%
b. No, not under any circumstances 61%
c. I already bicycle to campus at least one day a week 6%

d. There were facilities on campus for bicycle maintenance, such as puncture repair and tire inflation services and equipment.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>8%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>9%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>33%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>50%</td>
</tr>
</tbody>
</table>

e. There was more bicycle parking near the buildings I visit on campus.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>8%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>12%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>33%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>48%</td>
</tr>
</tbody>
</table>
f. There were covered bike parking that would discourage someone from vandalizing or stealing my bicycle.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>6%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>9%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>27%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>58%</td>
</tr>
</tbody>
</table>
g. There were facilities where I could change and/or shower once on campus (answer this if you are faculty or staff).

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Unlikely</td>
<td>15%</td>
</tr>
<tr>
<td>Somewhat Unlikely</td>
<td>11%</td>
</tr>
<tr>
<td>Somewhat Likely</td>
<td>33%</td>
</tr>
<tr>
<td>Very Likely</td>
<td>41%</td>
</tr>
</tbody>
</table>

32. Please briefly tell us why you would not bicycle...
to campus under any circumstances (e.g. too far, too dangerous, it’s too hot, I can’t ride a bike) (Open ended).

33. Please rank the following from least important to most important when it comes to choosing your means of transportation to campus.

a. Convenience/Flexibility

<table>
<thead>
<tr>
<th>Importance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>1%</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>5%</td>
</tr>
<tr>
<td>Important</td>
<td>27%</td>
</tr>
<tr>
<td>Most important</td>
<td>67%</td>
</tr>
</tbody>
</table>

b. Cost

<table>
<thead>
<tr>
<th>Importance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>6%</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>18%</td>
</tr>
<tr>
<td>Important</td>
<td>38%</td>
</tr>
<tr>
<td>Most important</td>
<td>38%</td>
</tr>
</tbody>
</table>

c. Reducing pollution, conserving energy

<table>
<thead>
<tr>
<th>Importance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>17%</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>31%</td>
</tr>
<tr>
<td>Important</td>
<td>36%</td>
</tr>
<tr>
<td>Most important</td>
<td>15%</td>
</tr>
</tbody>
</table>

d. Safety

<table>
<thead>
<tr>
<th>Importance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>5%</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>12%</td>
</tr>
<tr>
<td>Important</td>
<td>34%</td>
</tr>
<tr>
<td>Most important</td>
<td>49%</td>
</tr>
</tbody>
</table>

e. Travel Time

<table>
<thead>
<tr>
<th>Importance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>2%</td>
</tr>
<tr>
<td>Somewhat important</td>
<td>6%</td>
</tr>
<tr>
<td>Important</td>
<td>29%</td>
</tr>
<tr>
<td>Most important</td>
<td>63%</td>
</tr>
</tbody>
</table>
## Appendix II: List of Transportation Modes by Person-Miles per Gallon (PMPG)

<table>
<thead>
<tr>
<th>Transport</th>
<th>Average PMPG</th>
<th>Max PMPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle [3]</td>
<td>984.0</td>
<td>984.0</td>
</tr>
<tr>
<td>Walking [1]</td>
<td>700.0</td>
<td>700.0</td>
</tr>
<tr>
<td>Freight Ship [10]</td>
<td>340.0</td>
<td>570.0</td>
</tr>
<tr>
<td>Running [2]</td>
<td>315.0</td>
<td>315.0</td>
</tr>
<tr>
<td>Freight Train [7]</td>
<td>190.5</td>
<td>190.5</td>
</tr>
<tr>
<td>Plugin Hybrid [5]</td>
<td>110.6</td>
<td>350.0</td>
</tr>
<tr>
<td>Motorcycle [4]</td>
<td>71.8</td>
<td>113.0</td>
</tr>
<tr>
<td>Passenger Train [7]</td>
<td>71.6</td>
<td>189.7</td>
</tr>
<tr>
<td>Airplane [9]</td>
<td>42.6</td>
<td>53.6</td>
</tr>
<tr>
<td>Bus [8]</td>
<td>38.3</td>
<td>330.0</td>
</tr>
<tr>
<td>Car [4]</td>
<td>35.7</td>
<td>113.0</td>
</tr>
<tr>
<td>18-Wheeler (Truck) [5]</td>
<td>32.2</td>
<td>64.4</td>
</tr>
<tr>
<td>Light Truck, SUV, Minivan [4]</td>
<td>31.4</td>
<td>91.0</td>
</tr>
</tbody>
</table>

[1] Walking: A typical person expends roughly 75 calories to walk a mile in 20 minutes. An American burns about 30 calories just to exist for 20 minutes, so the net expenditure for walking is 45 calories per mile. One gallon of gasoline contains roughly 31,500 kcal, so 45 calories is 0.0014 gallons of gas. Thus the average American has a walking efficiency of 700mpg. This estimate is higher than that given elsewhere – the crucial difference is that you have to subtract out baseline metabolism, since an American consumes over 2100 calories a day just to stay alive.

[2] Running: The calculation is similar to [1]. Here we assume a 6 minute/mile pace, which burns 1088 calories per hour, or 109 calories per mile, and 100 net calories per mile. 100 calories is 0.003 gallons of gas, for a fuel efficiency of 315mpg.

[3] Bicycles: Bicycling at 10mph requires 408 calories per hour, or 40.8 calories per mile, which is 32 net calories per mile. This yield an mpg rating of 984, higher even than walking!

[4] Automobiles: The Bureau of Transportation Statistics has done the heavy lifting for us, calculating BTU per passenger-mile for cars, light trucks, and motorcycles. For cars, the latest (2008) data point is 3501 BTU / passenger-mile, or 0.028 gallons per passenger-mile, which equals 35.7 pmpg (BTS assumes 1.58 passengers on average, so this equates to 22.6 mpg). Using the same BTS data, average pmpg for light trucks is 31.4, and for motorcycles is 71.76. For max pmpg, we use a max passengers of 5 for cars and trucks, and 2 for motorcycles. To do this calculation from the BTS data, we first divide the avg. pmpg by the avg. passenger count, and then multiply by the max in each case.

[5] 18-Wheelers: For 18-wheel rigs, BTS data shows an average diesel mpg of 5.1. This equates to a gasoline mpg of 4.6, using 125,000 btu / 138,700 btu as the gas / diesel energy ratio. The weight limit for trucks on most roads is 80,000 lbs, of which 55,000 might be the max load given a truck weight of 25,000 lbs. To convert load to passengers, I assume 4000 lbs per passenger, since that’s roughly the weight of a passenger vehicle. A 50% (average) loaded truck counts for roughly 7 passengers, and a full load counts for 14. Using these factors, average pmpg is 32.2 and max pmpg is 64.4.
[6] Plugin-Hybrids: With the exception of the Prius Hymotion conversion, plugin hybrids like the Chevy Volt have yet to reach market, and have not yet had a final mpg designation. Consumer Reports achieved 67 mpg with the Hymotion Prius, though Hymotion and many owners claim 100 mpg is possible. Using 70 mpg, and adjusting this by the 1.58 average passenger count, the Hymotion Prius has an average pmpg of 110.6, and a maximum pmpg of 350.

[7] Trains: While all trains have similar underlying efficiencies, passenger trains in the US are much less efficient in practice because of poor utilization. BTS calculates Amtrak efficiency at 1745 BTU per passenger-mile, which equates to 71.6 pmpg. Amtrak traveled 267 million car-miles in 2007, which equals to 16 billion potential passenger miles if the average car holds 60 passengers. In 2007 Amtrak consumed 10.5 trillion BTU of fuel, or 659 BTU per available passenger mile. Amtrak's max pmpg is therefore 189.7 (if somebody would just ride it).

Freight trains consume 328 BTU to move a ton one mile. Using 4000 lbs of freight equals one passenger, this equals 656 BTU per passenger-mile, or 190.5 pmpg.

[8] Buses: At average passenger loads, buses achieve 3262 BTU per passenger-mile, or 38.3 pmpg. Per BTS data, buses average 6.1 diesel mpg, or 5.5 gas mpg. With a full load of roughly 60 passengers, a max pmpg of 330 is possible. The huge difference in average and max pmpg implies that buses are usually almost empty – perhaps smaller mini-buses should be used by more fleets.

[9] Airplanes: Airplanes flying domestic routes average 2931 BTU per passenger-mile, or 42.6 pmpg. The overall domestic load factor in 2008 was 79.6%, so at max capacity a plane might achieve 53.6 pmpg.

[10] Ships: In a previous post I found that shipping over water (by barge) costs one-third of shipping by rail. This implies that water based shipping is also roughly triple the efficiency in energy terms, since energy is one of the key cost drivers in transportation. This provides a rough estimate of 570 pmpg. According to this post, the world's largest container ship travels 28 feet on a gallon of residual fuel oil (149,690 BTU or 1.2 gallons of gas). This equals 0.004 mpg. Per Wikipedia, the ship can carry 11,000 14-ton containers, or 77,000 passenger-equivalents using our 4000 lb conversion rate. Thus pmpg is 340 for this ship.

REFERENCES


U.S. Environmental Protection Agency. My Trip Calculator. Office of Transportation and Air Quality. Available at: www.fueleconomy.com