Commuting Behavior and Transportation Preferences of the CSUN Community

March 27, 2019

CSUN | INSTITUTE FOR SUSTAINABILITY

Executive Summary

In 2010 and 2015, California State University, Northridge (CSUN) conducted its first and second complete surveys of the commuting habits of its students, staff and faculty. Here we report on the results of our third survey conducted and administered online between February 21 and March 10, 2018. The survey was distributed to approximately 12,300 randomly selected students, as well as all 4,415 faculty and staff at CSUN, and garnered a 28% total response rate. Students had a 13% response rate (1,589 student respondents) and 71% faculty and staff response rate (1,145 faculty and 1,992 staff respondents).

The campus community travels an average of 11 miles (12.4 miles excluding students living on campus) each way to CSUN, with students coming from an average distance of 7.63 miles (10.51 miles excluding students living on campus), staff traveling 25.96 miles, and faculty travelling 18.6 miles. Outliers were excluded from all three groups. Survey results indicate that students, staff and faculty commute to campus an average of 4.1, 4.7 and 3.2 days a week, respectively. Thus, the daily footprint of staff is highest considering the distance traveled and the number of trips made to campus per week relative to students and faculty.

All groups continue to use private automobiles as the primary mode of choice, but that is changing. More specifically, in 2010, 72% of students commuted via single occupancy vehicle (SOV) compared to 59% in 2015. In 2018, only 49% of students commuted via SOV. This is a substantial decrease for students. In contrast, staff and faculty continue to commute via SOV. Specifically, in 2010, 75% of campus employees traveled to campus via SOV, and in 2015 that number dropped to 73%. In 2018, we found that 76% of campus employees commute via SOV.

Since 2010, CSUN has incentivized alternative modes of transportation through a number of measures including: the construction of a transit station to bring buses directly to campus; building enhanced bicycling infrastructure such as new bike lines, LimeBike, and improved bicycle parking facilities; and subsidizing vanpool and public transit passes. These incentives have changed behavior. For example, bicycling among students increased from 3.4% in 2010 to 4.2% in 2015, and in 2018, 20.9% of students reported bicycling to campus. Bicycling has also become a more popular form of transportation for faculty and staff. Just 2.8% of employees commuted by bike in 2010, and 1.7% in 2015, but that number increased to 9.6% in 2018. Overall, 51% of students and 24.2% of faculty and staff commute by some other means than SOV.

The changes in commuting patterns have big impacts on the environmental footprint of CSUN. That is, while the annual per capita carbon footprint has remained relatively stable--Students: 1.00 tonnes CO_2 in 2010, 0.99 in 2015, and 1.02 in 2018; Faculty: 1.76 tonnes of CO_2 in 2010, 1.17 in 2015, and 2.05 in 2018; Staff: 2.08 tonnes in 2010, 1.89 in 2015, 1.04 in 2018--the campus's rate of increase in emissions has slowed substantially over the years. That is, because of campus growth, the overall footprint increased from 44,519 tonnes in 2015 to 46,199 tonnes in 2018. However, our campus population grew by 17% during that same time and only experienced a 3% increase in emissions.

In sum, emissions per person have decreased over the years, but there is still a lot of room for improvement. Thus, it continues to be CSUN's goal to reduce carbon emissions associated with commuting. To achieve our goals discussed in the 2016 Climate Action Plan, the university will continue to encourage alternatives to SOVs, provide incentives for using mass transit, and expand our EV charging station program to make commuting in electric and hybrid vehicles easy and convenient. In addition, we will continue to educate our campus community about the importance of reducing emissions and the relationship between transportation and climate change.

I would like to thank the students and campus employees who participated in our campus commuting survey, and the staff and student assistants at the Institute for Sustainability who helped with the preparation of this report, especially to our Student Research Assistant Gina Gerlich.

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Commuting Practices at CSUN

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 seeks 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 4,415 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 and second surveys were conducted in spring 2010 and spring 2015. 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, an on-campus transit center, and LimeBike. To understand the effects of those transportation and housing initiatives and to re-assess the transportation footprint, a third survey was conducted in spring 2018 and distributed to a random sample of faculty, staff, and students. The survey was administered online between February 21 and March 10, 2018 and distributed to approximately 16,700 randomly selected members of the CSUN community. There was a 28% response rate

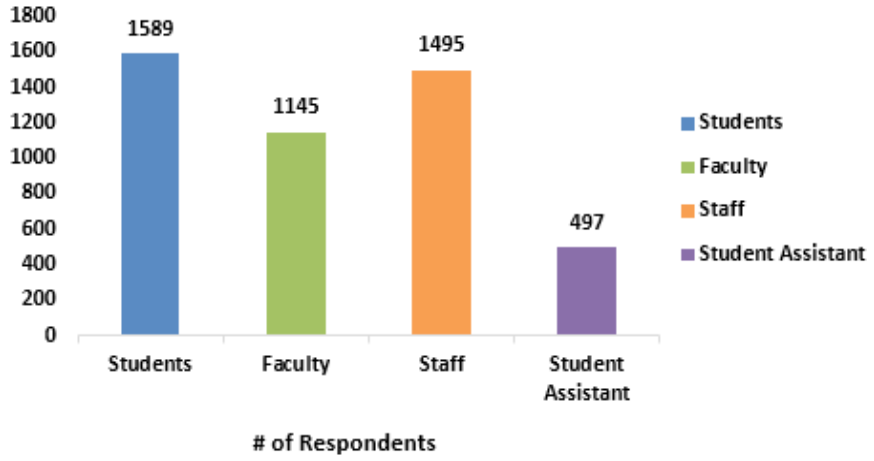

Figure 1. Demography of survey respondents (N=4726)

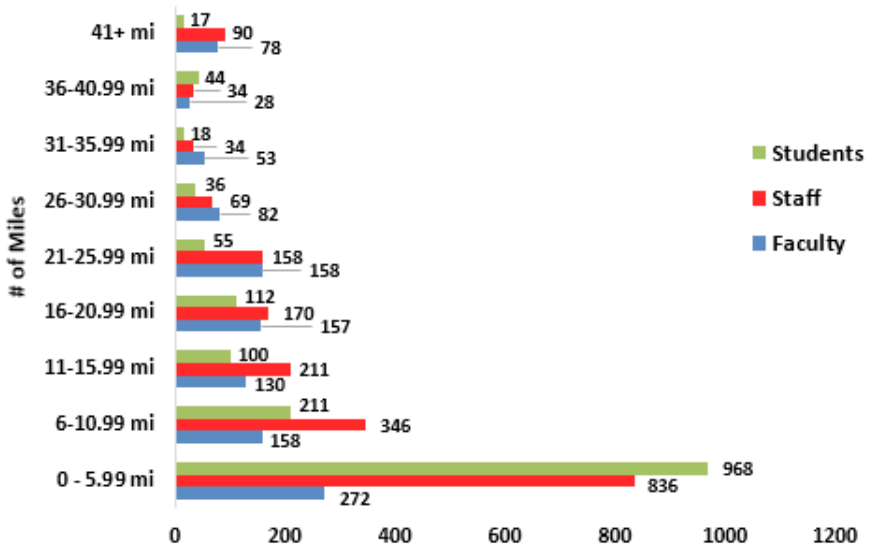

Figure 2. One-way commuting distances for faculty, staff, and students (N=4625)

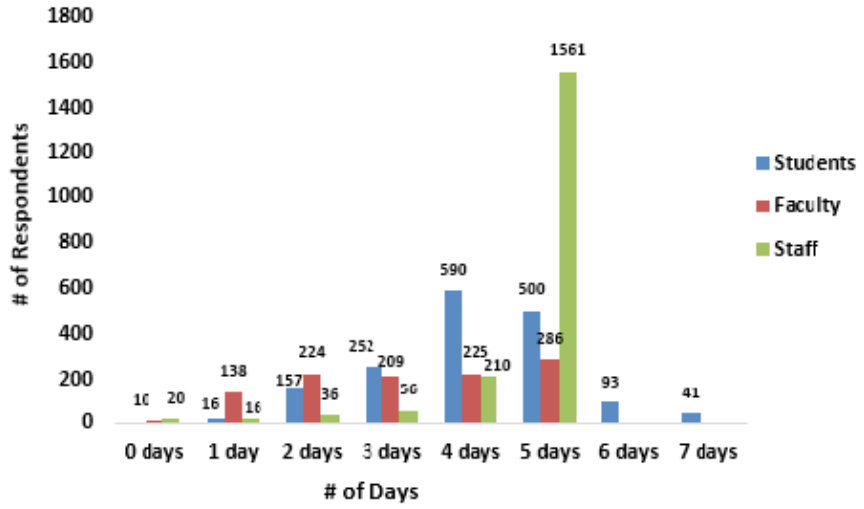

Figure 3. Number of days come to campus (N=4640)

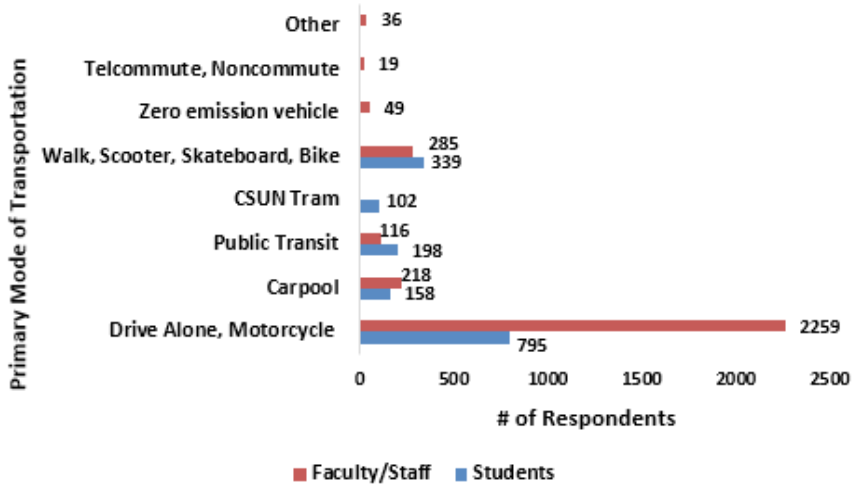

Figure 4. Primary mode of transportation for 2018 (N=4574)

with 4,726 respondents between students, faculty, and staff completing the survey. The survey included information on commuting distance, mode choice, transportation preferences and challenges. The purpose of the survey was 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 and spring 2015 surveys. CSUN has made several changes to transportation infrastructure and extended transportation options in the last 10 years. Therefore, a comparison of the three surveys allows us to examine the impacts of those change on commuting behavior and the emissions associated with commuting. The surveys also help the university to craft policies that encourage commuters to use more sustainable transportation options in and around campus, and to assess our progress towards our carbon neutrality goals as outlined in the 2016 Climate Action Plan.

Figure 1 shows the breakdown of respondents by type. Student assistants were later included as staff, as they answered questions in the staff portion of the survey.

Commuter Behavior and Transportation Preference

Commuting distance

Faculty, staff, and students were asked to estimate one- way travel distances from home to the CSUN campus. This is shown in Figure 2 in increments of 5 miles up to 41+ miles, with individuals beyond 41 miles being grouped together. The results show that the largest number of respondents indicated that they travel within 5 miles of the CSUN campus, with the percentages steadily decreasing for each increment until 41+ miles, where numbers increase. The average one way distance is 11 miles for the overall survey respondents, whereas, it is 18.6 miles for faculty, 25.96 miles for staff, and 7.63 miles for students respectively (including students living on campus, and after removing outliers for all three groups).

The number of days in a week that individuals typically commute to campus was assessed, with Figure 3 showing that students typically commute four days (36%), most staff come five

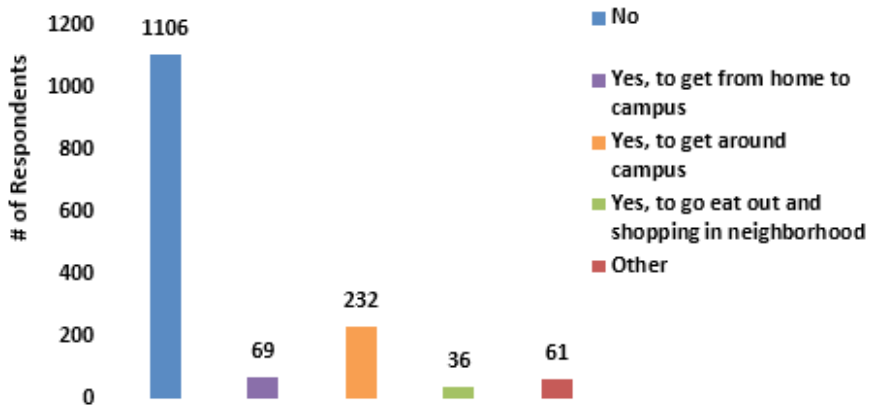

Figure 5. LimeBike usage for students (N=1504)

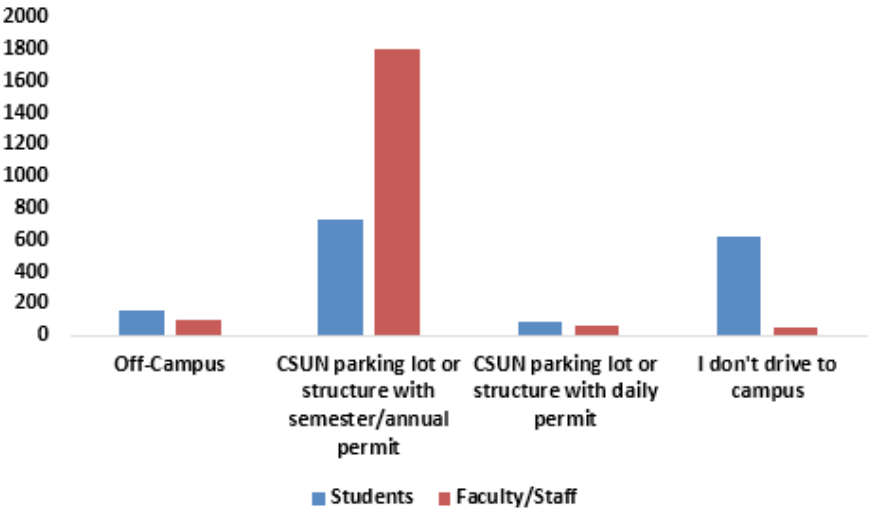

Figure 6. Parking choices of Students and Faculty/Staff (N=3608)

days (80%), and faculty mostly commute three days (19.6%). Overall, CSUN students, staff and faculty commute to campus an average of 4.1, 4.7, and 3.2 days a week, respectively. This information is relevant to computing the per capita CO_2 emissions.

Mode choice

As displayed in Figure 4, data on primary mode of transportation were gathered from the 2018 survey and can be compared with data from the 2010 and 2015 surveys published online. Respondents chose from a list of modes they generally take to campus. As was found previously, results for all groups indicate that the private automobile is the primary mode choice. However, there are signs of change. In 2018, 50% of students commuted via SOV, which decreased from 59% in 2015 and 72% in 2010, demonstrating a substantial reduction in the use of SOVs to commute to campus. In addition, in 2018, students reported carpooling more frequently (~10%) than was found in both 2015 (~6%) and 2010 (~3%). A high percentage also use other modes such as bicycles, skateboarding, scootering, the CSUN housing tram, and walking (~27.2%). It is worth noting the significance of changing student behavior given that, by far, students make up the bulk of campus population; over 40,000 students are enrolled in classes and commute to campus, and only 4,415 staff and faculty are employed. Thus, shifting student behavior and commuting norms has a much larger impact than for employees.

In 2018, CSUN introduced a discounted bikeshare program, LimeBike, on campus. This gave our campus community a new mode of transportation to use on and around campus. Figure 5 shows that 26.4% of students report using LimeBike at least some of the time, which is impressive given that the program began just months before this survey was conducted. Of the students who use LimeBike, 15.4% use it to get around campus. The hope is that students who live relatively close to campus will explore the potential of using a bicycle to commute to campus instead of their SOV. 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.

A shuttle service was created for students living in student housing, and many students report using this free service. Expanding the shuttle service to commuters who live within a 3-mile radius of campus could be one way to reduce carbon emissions associated with SOVs even further.

Electric Vehicle

Questions regarding electric vehicles (EVs) were asked. Figure 7 shows the number of people who currently own or lease an EV. Only 1.8% (1.9% of faculty and staff and 1.7% of students) of campus commuters report owning an EV, which is lower than the national average of 2.5% of new car sales during 2014 (Sierzchula, 2015). We also asked whether or not users charged their EVs on campus, to which an aggregate of 85% of respondents said that they do. More faculty and staff charge their EV on campus compared to students (Figure 8) but that is because more faculty own an electric vehicle than students.

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 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 (Figure 9). Having to take more than one bus complicates and lengthens travel and is also more expensive, making such a sentiment understandable. Clearly the most important factors driving the use of public transit are convenience and travel time rather than cost or comfort.

When it comes to factors that influence the student's use of carpool services (Figure 10), convenience is the most important. Distance required for travel also influences their use of carpool services. Students are also con-

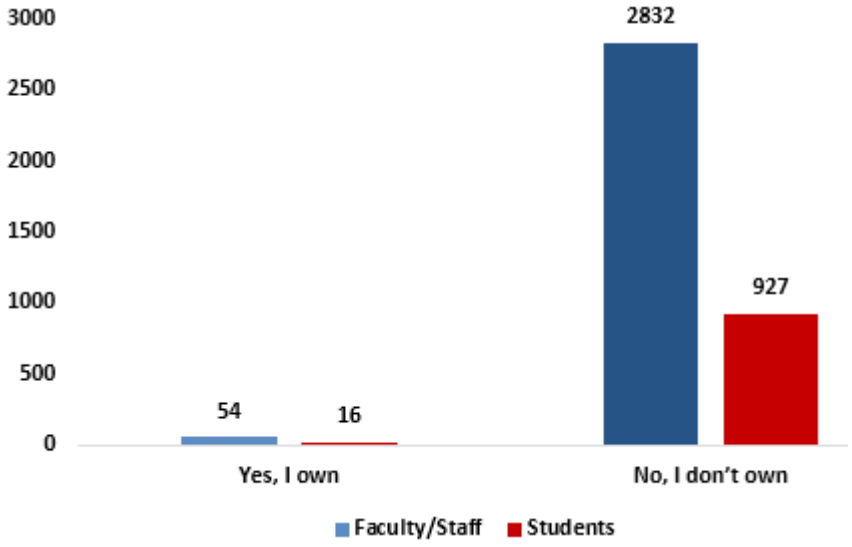

Figure 7. Electric vehicle ownership for students and faculty/staff (N=3829)

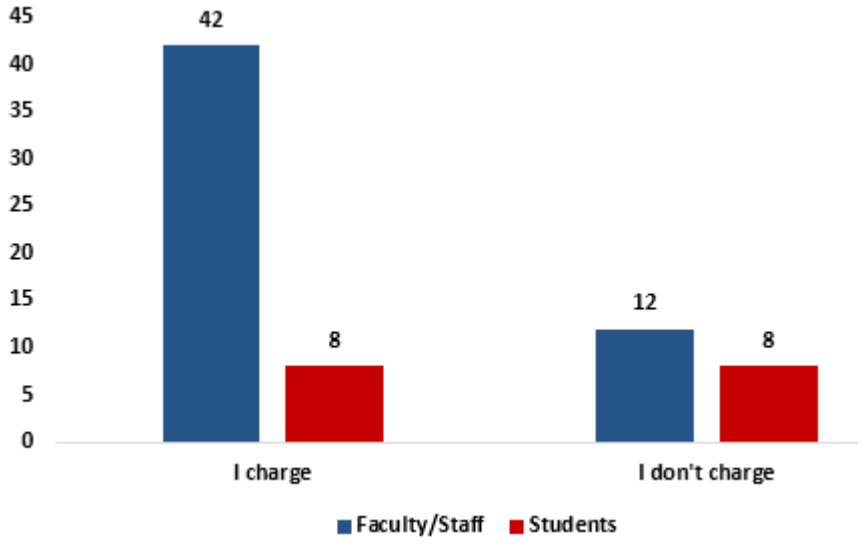

Figure 8. Do you charge on campus? (N=70)

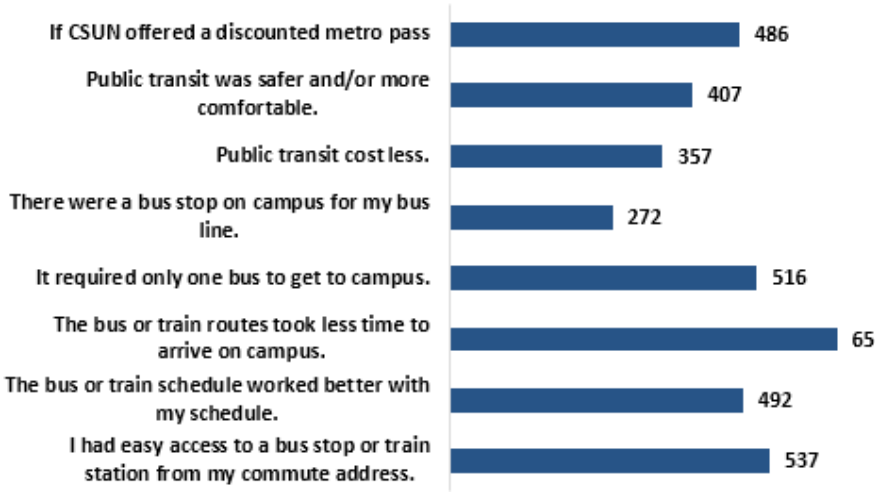

Figure 9. Factors affecting public transportation usage

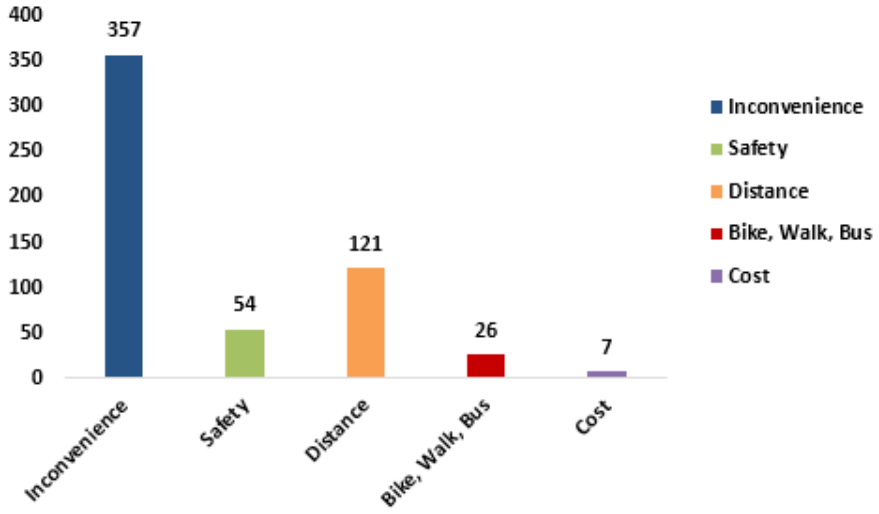

Figure 10. Factors affecting why students do not carpool (N=565)

cerned about safety, and would prefer knowing the other rider(s).

The last of the questions concerned use of bicycles. Students indicated that the primary reasons for not biking are due to an inability to bike and/or a dislike for biking. Other factors affecting bicycle usage were safety and distance (Figure 11). Students also desired to see improved bike routes off campus, which would facilitate easier and safer travel to and from 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 bicycles 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 ride a bicycle or use public transit came down to just that; if they own a car, why would they use a different mode? 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 that they wouldn't feel safe traveling with strangers, and for bicycling, 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 12 shows results from a question concerning how respondents choose their method

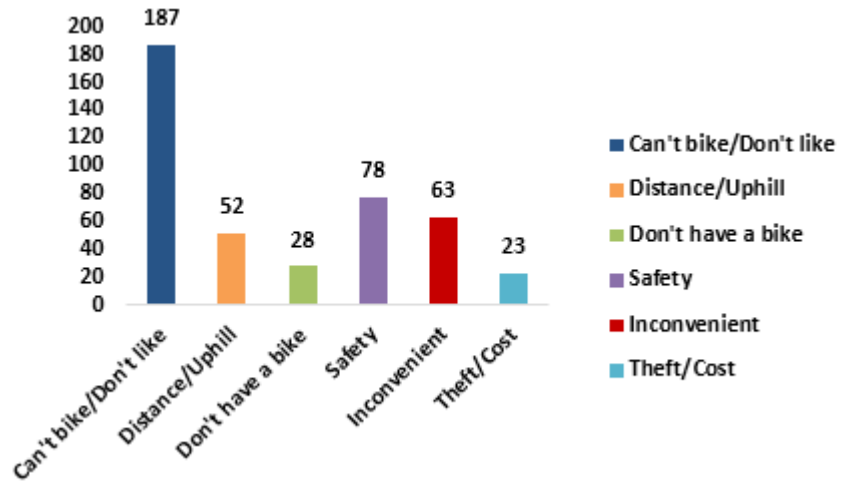

Figure 11. Factors affecting students choosing not to ride a bicycle (N=431)

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 the least polluting. Reducing pollution was ranked as least important in comparison to all other options, which is a major problem that needs to be addressed.

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 CO_2 emissions that these choices generate. Emissions from transportation are significant in the increase of greenhouse gases leading to climate change, poor air quality, and accompanying health issues.

CSUN is an institution that primarily serves students who live off campus, so carbon emissions from commuting are of particular concern. To calculate energy used and accompanying CO_2 emissions, the following components of the survey were utilized: number of trips per week; distance in miles, percent of students, faculty, and staff traveling by each transportation mode; and miles per gallon (mpg) of the vehicle or mode used. Responses to car make, model, and year were used to determine the average miles per gallon, and to calculate energy consumption and CO_2 emissions.

Vehicle fuel economies were calculated using fueleconomy.gov, an online resource provided by the Environmental Protection Agency. Data provided on this website includes the total mpg of the make and model of common vehicles manufactured between 1985 and 2019. 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 to 2,543. From these data averages for mpg, number of trips per week to CSUN, and approximate miles (one way) were established. Using numbers of student,

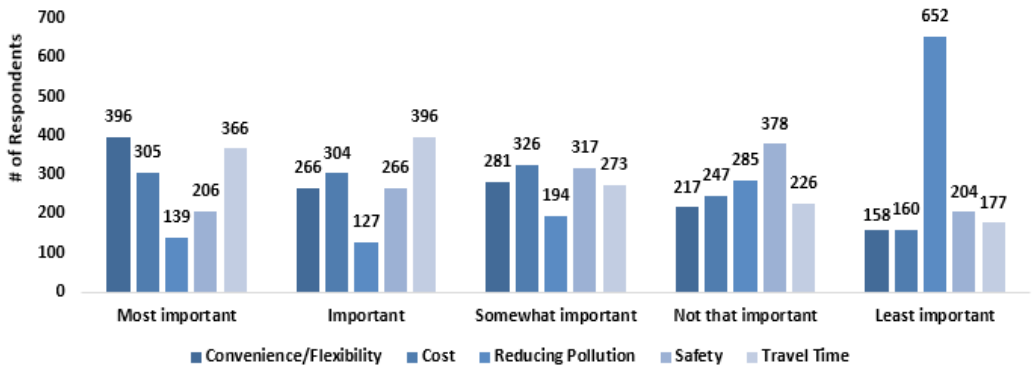

Figure 12. Ranking of importance for choosing method of transportation

faculty, and staff responding, percentages for each mode of transportation were calculated, with the modes studied being car/motorcycle, carpool, public transportation, CSUN shuttle/tram, and Other. Average mpg for car/motorcycle, carpool, public transportation, CSUN shuttle/tram, and other were used to determine gasoline, energy consumption and CO_2 emissions, and verified using truecostblog.com (APPENDIX 2).

Gasoline, energy consumption, and CO_2 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. CO_2 emissions = Gallons of gasoline x CO_2 conversion factor (lbs CO_2/gallon)

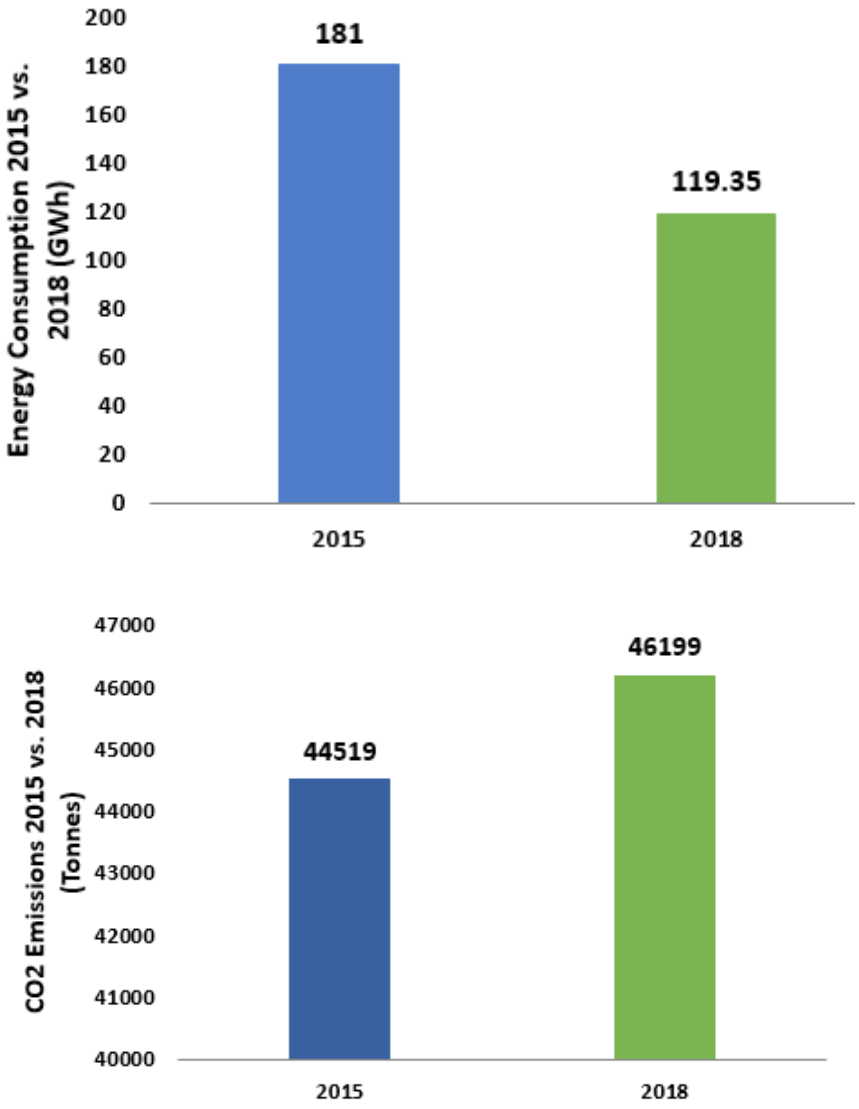

Figure 13. 2015 and 2018 comparisons of energy consumed and CO_2 emitted

The results from these equations were used to determine CO_2 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 CO_2 conversion factors used were 19.64 lb of CO_2 per gallon of gasoline, 22.2 lb of CO_2 per gallon of diesel, and 0.379 lb CO_2 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.

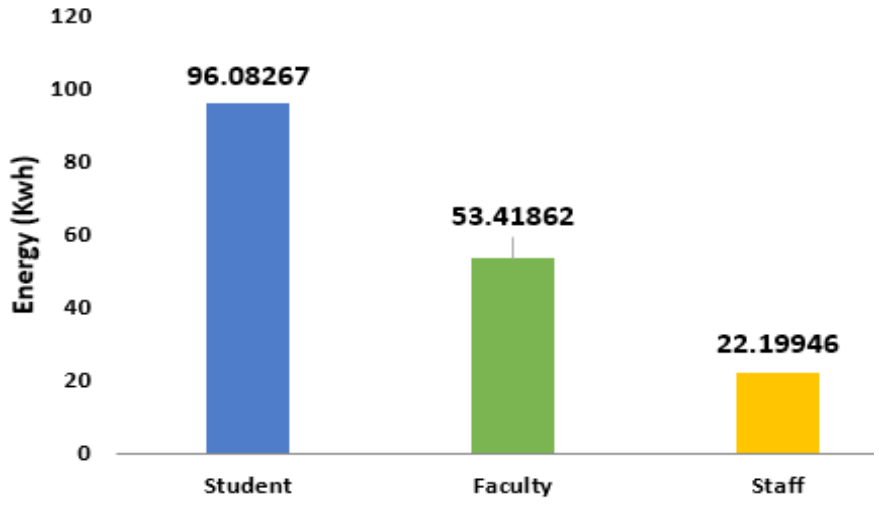

Figure 14. Energy consumed per capita per week (kWh)

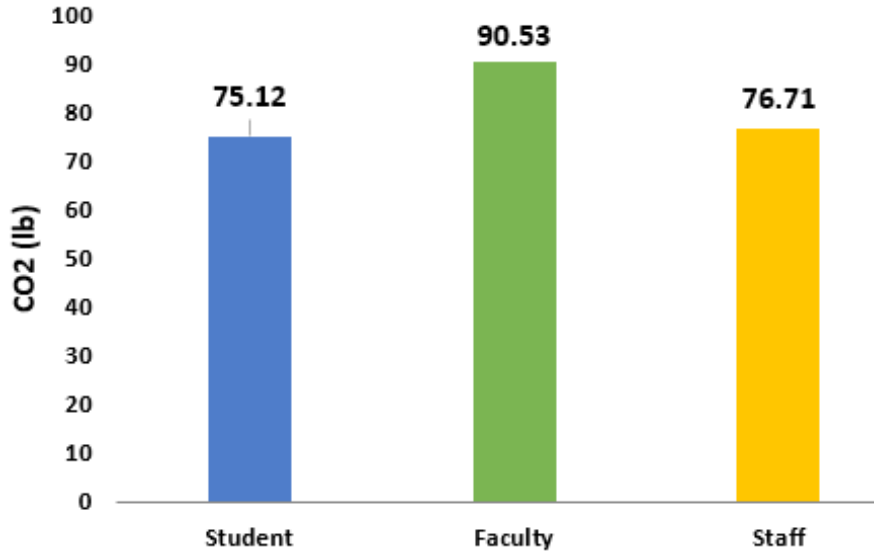

Figure 15. CO_2 emitted per capita per week (lb)

There was a particular interest in the comparison of energy consumed and CO_2 emissions with the data from the survey conducted in 2015. Figure 13 shows that the total annual energy consumption for 2018 was 119.35 GWh, while 2015 yielded a total of 181 GWh. According to the 2015 survey, the calculated annual CO_2 was 44,519 tonnes whereas in 2018 it is 46,199 tonnes. The result shows an increase of carbon emissions, and a decrease in energy consumption over a three year period. This can be attributed to faculty, staff, and students estimating their travel distance as round trip rather than one-way.

Where per capita energy consumption, CO_2 emissions, and gasoline consumption are concerned, Figures 14-16 show that faculty members have relatively higher values in CO_2 emitted and gasoline consumed when compared to students and staff. This is due to the fact that a high percentage of faculty drive alone as indicated in Figure 4, but there were also more faculty and staff who answered the survey in comparison to students. Therefore, numbers may be skewed. Students used substantially more energy compared to faculty and staff.

Conclusions and Recommendations

The survey results show that in the last eight years, CSUN has experienced a major modal shift in students. That is, rather than driving alone, more students are using alternative modes of transportation, especially walking and biking. This could be attributed to an increase in the number of students who choose to live close to campus, as well as the introduction of incentives for alternative transportation such as discounted public transit passes and LimeBike. Faculty and staff also utilize a variety of commuting modes. Of those who do not use the same method of transportation to commute each day, 56% include some other method of transportation (carpool, public transit, biking, walking, etc.). However, 90% of faculty and staff use the same method of transportation, and of those, 78% use SOV. This

shows that multi-modal travel is important, and by focusing future efforts on increasing the viability of alternative modes of transportation, SOV usage would decrease overall.

It is important to note that CSUN's EV use is lower than the national average. Although this is discouraging given our efforts to provide free charging stations for EV commuters, users would like to see more charging stations, and strategic locations for them. These strategies would likely increase the use of environmentally friendly vehicles on campus.

This study also shows that there is an increase in CO_2 emissions in 2018 compared to the 2015 data. This may be attributed to the estimation of travel time by round trip rather than one-way that was estimated in the 2015 survey, and there were more respondents in the 2018 survey as compared to the 2015 survey. However, given that our campus has grown 17% in the past three years, the increase in emissions was only 3%.

Efforts to curb the transportation-related carbon footprint of CSUN need to continue in order to meet the CSUN Climate Action Plan goals. This Plan includes a detailed strategy to achieve the goal of reducing or eliminating the carbon impact of the transportation sector. Educating our campus community about the relationship between transportation and climate change related GHG emissions is an essential component of this strategy.

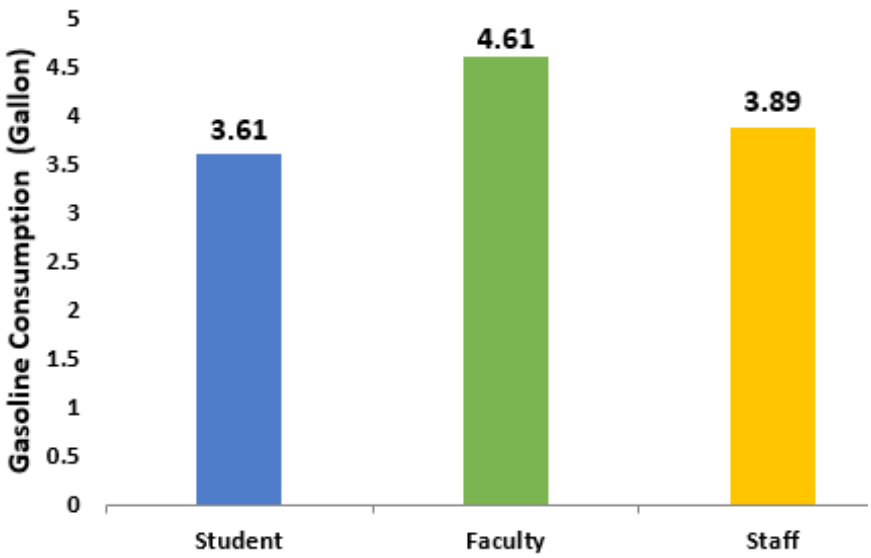

Figure 16. Gasoline consumed per capita per week (gallon)

Appendix I: CSUN Commuting Survey 2018
Student, Faculty & Staff Questionnaire and Results

Date Survey Conducted:	February 21 - March 10, 2018
Total Sample:	4,726
Students:	1,589
Faculty and Staff:	3,137

1. Which of the following best describes you?

a. Student	34%
b. Staff	42%
c. Faculty	24%

2. Do you live in CSUN student housing or off campus this semester?

a. Off-campus	73%
b. CSUN student housing	27%

3. 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 Response*

4. In a typical week this semester, how many days do you come to the CSUN campus? Check the boxes below.

Students	
0 days	0%
1 day	1%
2 days	9.5%
3 days	15.3%
4 days	35.8%
5 days	30.3%
6 days	5.6%
7 days	2.5%
Faculty/Staff	
0 days	1%
1 day	5%
2 days	9%
3 days	9%
4 days	14%
5 days	62%
6 days	0%
7 days	0%

5. Do you take the same method of transport to campus every day? If not, please explain your multiple methods of transport. *Open-Ended Response*

6. In a typical day this semester, at what time do you arrive at CSUN? *Open-Ended Response*

7. What is the primary mode of transportation that you use most often to come to the CSUN campus this semester? If you come to campus in carpool or rideshare, how many people usually occupy the vehicle, including yourself?

Students	
Drive alone, Motorcycle	50%
Carpool	10%
Public Transit	12%
CSUN Tram	7%
Walk, Scooter, Bike, Skateboard	21%
Zero Emission Vehicle	0%
Telecommute, Noncommute	0%
Other	0%
Faculty/Staff	
Drive alone, Motorcycle	76%
Carpool	7%
Public Transit	3%
CSUN Tram	0%
Walk, Scooter, Bike, Skateboard	10%
Zero Emission Vehicle	2%
Telecommute, Noncommute	1%
Other	1%

8. If you use public transit, how do you usually travel between the bus stop or train station and the CSUN campus?

a. Bicycle	1.8%
b. Bus	6.7%
c. CSUN Shuttle	7.0%
d. Someone drives me	2.4%
e. Walk	17.5%
f. I don't use the bus/train (public transit) to	

come to campus	63.2%
g. Other	1.4%

9. If you drive to campus this semester, where do you usually park?

Students	
a. CSUN parking lot or structure with a semester or annual parking permit	46%
b. CSUN parking lot or structure with a daily permit	5%
c. Off campus	10%
d. I don't drive to campus	39%
Faculty/Staff	
a. CSUN parking lot or structure with a semester or annual parking permit	90%
b. CSUN parking lot or structure with a daily permit	3%
c. Off campus	5%
d. I don't drive to campus	2%

10. Please enter the make, model, and year of the vehicle you drive to campus most often. *Open-Ended Response*

11. If your vehicle is electric, do you charge it on campus?

Students	
a. Yes	0.8%
b. No	0.8%
c. My vehicle is not electric	98.4%
Faculty/Staff	
a. Yes	1.5%
b. No	0.4%
c. My vehicle is not electric	98.1%

12. On a typical day, when you need to charge your vehicle, how often do you find a charging station available?

a. Rarely	71%
b. Not often	28%
c. Often	0%
d. Very often	1%

13. How satisfied are you with the location of the charging station (relative to where your office or classroom is located)?

a. Very Unsatisfied	50%
b. Somewhat Unsatisfied	14%
c. Somewhat Satisfied	35%
d. Very Satisfied	1%

14. What are your reasons for not charging while on campus? *Open-Ended Response*

15. Do you currently receive a reduced fare bus pass?

a. Yes	11%
b. No	89%

16. Please identify the reduced fare bus pass you most frequently use (select one):

Metro U-PASS for $95 (valid until the semester ends)	88.6%
Metro 30-day college/vocational (valid for 30 days at a time)	5.4%
Other agency (Please specify)	6%

17. If a reduced fare bus pass were not available to use, would you still attend CSUN?

a. Yes	83.2%
b. No	16.8%

18. Which of the following would increase the likelihood that you would take public transit to campus at least once a week if you do not already?

a. I had easy access to a bus stop or train station from my commute address.	14.5%
b. The bus or train schedule worked better with my schedule.	13.2%
c. The bus or train routes took less time to arrive on campus.	17.5%
d. It required only one bus to get to campus	13.9%
e. There were a bus stop on campus for my bus line.	7.3%
f. Public transit cost less.	9.6%
g. Public transit was safer and/or more comfortable.	11.0%
h. If CSUN offered a discounted metro pass	13.0%

19. If you don't already, would you be willing to carpool to campus at least one day a week this semester or in a future semester? Please explain why or why not. *Open-Ended Response*

20. If you don't already bike to campus, would you be willing to? Please explain, why or why not. *Open-Ended Response*

21. Do you use LimeBike to get to...

a. No	73.5%
b. Yes, to get from home to campus	4.6%
c. Yes, to get around campus (locations within campus, to get lunch off campus, from campus to your car)	15.4%
d. Yes, to go eat out and shopping in the neighborhood	2.4%
e. Other (please specify)	4.1%

22. Please rank the following from least important to most important when it comes to choosing your means of transportation to campus. Type the number1-5 in each box corresponding with your ranking.

a. Convenience/Flexibility

Least important	12.0%
Not that important	16.5%
Somewhat important	21.3%
Important	20.2%
Most important	30.0%

b. Cost

Least important	11.9%
Not that important	18.4%
Somewhat important	24.3%
Important	22.7%
Most important	22.7%

c. Reducing pollution

Least important	46.7%
Not that important	20.4%
Somewhat important	13.9%
Important	9.0%
Most important	10.0%

d. Safety

Least important	14.9%
Not that important	27.6%
Somewhat important	23.1%
Important	19.4%
Most important	15.0%

e. Travel Time

Least important	12.3%
Not that important	15.7%
Somewhat important	19.0%
Important	27.5%
Most important	25.5%

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As a thank you for your participation, we will be giving away four $25 gift certificates to the CSUN Bookstore. All who complete the survey have the opportunity to enter themselves into a drawing for a chance to win one of the gift certificates. Winners will be notified by email when data collection is completed. If you would like to be entered into the drawing, please enter your email_____

Appendix II: List of Transportation Modes by Person-Miles per Gallon (PMPG)

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

[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 our 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 yields 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.

(Source:http://truecostblog.com/2010/05/27/fuel-efficiency-modes-of-transportation-ranked-by-mpg/)

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