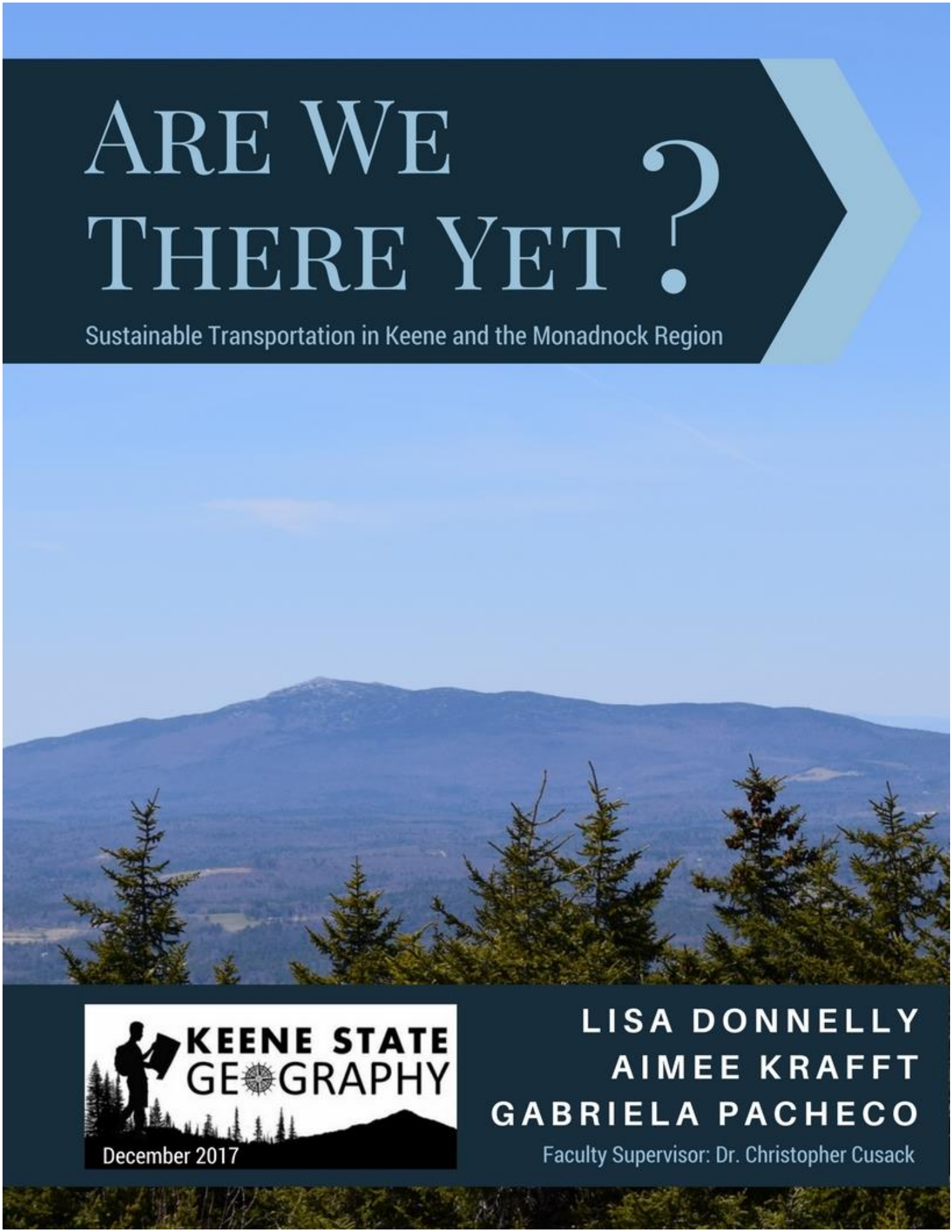
Are We There Yet?

Sustainable Transportation in Keene and the Monadnock Region



KEENE STATE GEOGRAPHY

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LISA DONNELLY
AIMEE KRAFFT
GABRIELA PACHECO

Faculty Supervisor: Dr. Christopher Cusack

About the Authors

Lisa Donnelly is a Senior Geography major from Brattleboro Vermont, where she lives with her boyfriend and three children; Adam, Zahra, and Eliana. She loves reading, PC gaming, travel, and the outdoors. She also loves GIS and hopes to use the skills she acquired at KSC to make the world a better place.

Gabriela Pacheco is a Senior Geography and Environmental Studies major from Bethel, Connecticut. She hopes to continue expanding her knowledge of the world and environment as she focuses her career on water management. In her free time, she enjoys playing the guitar, hiking and skiing. Gabriela's favorite memory from Keene State College is the opportunity to travel to Hawaii through a geography field course, a trip that helped her realize her love for Geography.

Aimee Krafft is a Senior Geography and Environmental Studies major from Milford, New Hampshire. She loves running and spending time outdoors. In addition to traveling, she hopes to expand her knowledge through further education, and then use the skills she has acquired throughout future career choices.

Dedication

Aimee Krafft

To my parents whose unconditional love has provided me with unwavering support. To my sisters, Jessica and Robyn who have taught me that multiple minds are better than one.

Gabriela Pacheco

To my Mother and Father, Janeth and Edgar, who have supported and helped me toward success every step of the way throughout my college career. To everyone at 85 Wilson Street for making my time at Keene State College unforgettable.

Lisa Donnelly

This work is dedicated to my family. To my parents Alan and Melanie Donnelly and my sister Tara Robertson, for believing in me. To my children Adam, Zahra, and Eliana – my inspiration. To John Paxton, whose hard work and patience made my education possible. And finally, to my grandparents, Robert and Janet Applebaum.

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Abstract

This study examines three different forms of sustainable transportation for the Monadnock Region, and specifically Keene, New Hampshire. As sustainability is steadily gaining popularity throughout southwest New Hampshire, the availability of 'green' forms of transportation are important for area residents. Working with the Monadnock Alliance for Sustainable Transportation, (MAST), the potential for sustainable forms of transportation in the Monadnock region and the City of Keene is researched so as to provide an overview of existing conditions and an analysis of future ones. The project is threefold, focusing on carshare, rideshare, and the City Express bus in Keene.

Data from two different surveys were collected, one targeted toward Keene State College students and the other focused on the residents of the Monadnock Region. The Keene State College student survey was conducted on paper and included carshare, rideshare and the City Express. The Southwest Region Planning Commission conducted an online survey for the Monadnock Alliance for Sustainable Transportation, which collected data on carshare interest from residents throughout the region. Data from the surveys were analyzed using the Statistical Package for the Social Sciences (SPSS). City Express data were mapped using ArcGIS as a visual platform, and new potential bus stops were determined, using student survey feedback. Our goal is to determine the success of future established forms of transportation and the potential success of non-established forms of sustainable transportation in the Monadnock Region.

Key words: Sustainable, Transportation, Carshare, Rideshare, City Express, Surveying

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Chapter 1

Introduction

Sustainable development is defined as meeting present needs without negatively impacting future generations (EPA 2016). Pursuing sustainability in a region means to create and maintain infrastructure that promotes healthy conditions in which human and nature exist productively and simultaneously. Major achievements in sustainable development can be seen in regions all across the country, including investments in green infrastructure, conservation initiatives, and the encouragement of community. The Monadnock Region in southwest New Hampshire, where sustainability is steadily gaining popularity, is no exception. Specifically, the City of Keene, New Hampshire, has been promoting its sustainability efforts through the Green Up Keene program, which includes the establishment of the Climate Protection Committee, environmental events like Complete Streets demonstrations, the Greenhouse Gas Inventory, and Green Business Awards. Additional efforts include the practice of using reclaimed, recycled, and sustainable materials in construction projects, reducing greenhouse gas emissions through efficiency and renewable energy, and the increase in open and green spaces across the area (City of Keene 2010). Specific evidence of this commitment includes solar panels on the roof of City Hall, permeable pavement at the Keene Police Station, and electric car charging stations.

Figure 1.1: *Sustainability in the Monadnock Region. Created by Lisa Donnelly.*

The City is also putting effort into promoting sustainable transportation. Recently, Keene appointed its first Bicycle Mayor, a position that works to educate colleges and businesses on the health and economic benefits of bicycle programs (Union Leader 2017). Keene currently maintains an extensive network of bike paths, and many businesses and organizations further support bike riders by providing bike racks on their property. These efforts are further supported by Keene State College, which has worked to encourage sustainable transportation through the Green Bikes service, a program that has recently earned a silver level Bicycle Friendly University (BFU) award from the League of American Bicyclists (Keene State College 2017). Residents and visitors in Keene also have access to the City Express, a low cost public transportation system that has bike racks on every bus.

Although Keene and the rest of the Monadnock region has made some significant progress by promoting sustainability in a variety of ways, the overall development of sustainable transportation options is still somewhat lacking. As more people purchase and use privately owned vehicles, sufficient parking areas for residents along and adjacent to the downtown area remains limited. The influence of Keene State College located near the downtown area also exacerbates this parking issue because of the high number of students that own personal vehicles. Preference for personal vehicles over other forms of transportation contributes to congestion along high traffic areas, most notably on Main Street. The traffic congestion also has a substantial impact on air quality through the emission of carbon dioxide, particulates, carbon monoxide, and nitrogen oxides. In order to address these issues, Keene and the Monadnock region has been working on several potential solutions centered on the promotion or development of various transportation options (Figure 1.2). Therefore, the purpose of this study

is threefold: to explore the potential of bringing a carshare operation to the Monadnock region; to assess current ridesharing trends throughout the region; and to analyze the City Express bus system in Keene.

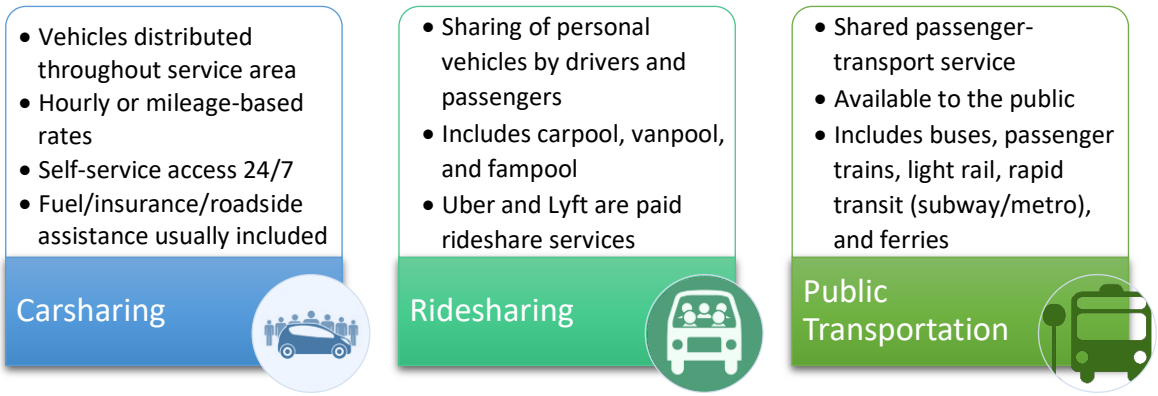


Figure 1.2: *Transportation methods to be examined in this study. Created by Lisa Donnelly.*

Hypothesis 1: *A carshare operation is more likely to be successful in Keene than in other towns within the Monadnock region, due to the presence of the student population in the city.*

Carsharing is a membership based service that offers short-term vehicle rental through access to a network of self-service locations. Becoming a member involves a prequalification process that requres a valid driver's license and good driving record. Vehicles are reserved through an app or online. Once a car is reserved the member is given a card or key that unlocks the car, depending on the carshare organization (Zipcar 2017). The three main models of carshare are: Peer to Peer, Business to Consumer, and Not-for-Profit or Co-op. Peer to Peer is when a private car is made available to other drivers to rent through use of a website or app. Examples of Peer to Peer include Whipcar and Getaround. Business to Consumer is when a company owns the fleet of cars and manages sharing between the members. Examples include Zipcar and GoGet. Not-for-Profit Carshare (like City Car Share) focuses on changing driving habits,

and is usually led by a community or local organization (The Future of Carsharing 2017). There is no established carsharing program in the Southwest region.

Hypothesis 2: *Due to a lack of awareness of online resources and limited regional infrastructure, most rideshares in the Monadnock Region are informal fampools and carpools.*

Ridesharing is the sharing of vehicles by passengers to reduce vehicle trips, traffic congestion and automobile emissions. Types of transportation that are considered rideshare include carpool and vanpool. Informal rideshare takes place both in Keene and the southwest region. There is also currently an established New Hampshire Rideshare website. The website provides information about all types of rideshare and offers a potential list of carpool matches to people that register. There are Park & Ride locations across New Hampshire that are designed to encourage commuter ridesharing by providing parking places for vehicles. The Chesterfield Park & Ride is the only location in the Southwest Region (NH Rideshare 2011).

Hypothesis 3: *Student Ridership on the City Express Campus Shuttle is low because the schedule and stop locations do not meet the transportation needs of the students.*

The City Express is a bus system and the only form of public transportation in the City of Keene. This form of public transportation is free to KSC students and $1 for Keene residents. The City Express is run through the Home Healthcare, Hospice and Community Services company in Keene. The bus operates Monday through Friday. There are currently two routes and an additional third route for the Campus/Community Shuttle. The bus currently stops throughout the city at sixteen different locations. The Campus/Community Shuttle currently stops at various places around Keene State College, as well as a few stores outside the campus (HCS 2014).

Chapter 2

Literature Review

Sustainable transportation refers to a variety of mobility options that positively affect the social and environmental impacts of the global transportation industry. The sustainable transportation methods specifically explored in this study include carsharing, ridesharing, and public transit. There are definite trends in ridership demographics for each option, as well as benefits and challenges associated with each alternative transportation method. A summary of the information presented in this literature review can be found in Appendix A.

Carsharing

Demographics

In 2014, carshare memberships in North America grew from less than one million members to more than 1.3 million, with an increase of more than 2,300 vehicles (Shaheen and Cohen 2016). For-profit carsharing operations like ZipCar and Enterprise Carshare have been hugely successful and are constantly expanding their services to new cities and college campuses. There are also a number of co-op carshares that have successfully introduced carsharing as a transportation option to their communities, including Carshare Vermont and Ithaca Carshare. In an effort to predict where future carshare operations will succeed, several studies have been conducted to identify who potential members are, where they live and work, and what their travel habits are.

One challenge that many cities and communities face is how to attract and retain skilled millennials. The United States Census Bureau defines millennials as people who were born between 1982 and 2000 (United States Census Bureau 2015). Studies have shown that millennials tend to choose to live in areas where a variety of transportation options are readily available. This supports the idea that carsharing can contribute to attracting young professionals

to the community, since most carshare members are adults between the age of 25 to 45 and many fall into that age group (Le Vine, Zolfaghari, and Polak 2014). People in this age group also hold fewer drivers' licenses and own fewer cars than previous generations. Many of them are single or childless couples with high levels of education and a middle to upper class income. Since carshare operations tend to do well in urban areas with high population densities, population density has long been considered a major factor in predicting whether or not a carshare will do well in a given area. However, Celsor and Millard-Ball (2006) identify other household characteristics that influence carsharing success, including low and high thresholds representing the levels of service needed to sustain or grow a carsharing operation. Their research demonstrates that some of the most important demographic data include the percentage of 1-person households, how many people drive alone or walk to work, households with no vehicle or only one vehicle, and housing units per acre.

Carshare members typically are people that frequently use other forms of transportation, such as bicycles, busses, and trains. Studies have shown that carshares tend to do well in places with several transportation options available, because carsharing acts as a compliment rather than competition. For example, someone who is able to rely on public transportation for most trips will only need the occasional use of a car, which makes a carshare membership a much more affordable and convenient option compared to private vehicle ownership.

Benefits

There are three main beneficial factors of adopting the carsharing program, these include environmental, economic, and social factors. Katzev (2003) discusses the role of the current transportation problem as well as the role of carsharing in major metropolitan areas. Private automobiles provide many benefits, however, also provide the most serious environmental problems. By adopting carsharing, automobile usage decreases along with a decline in a major source of air and noise pollution in large and populated U.S. cities. Private automobiles contribute to 70 percent of carbon monoxide emissions, 45 percent of nitrogen oxide emissions, and 33 percent of hydrocarbon emissions in metropolitan cities. A goal in carsharing is to reduce the number of cars on the road. Transportation in metropolitan cities consume about 67 percent of the petroleum use in the country. That is about 12 million barrels of oil per day. The dependence on so much oil for the transportation sector greatly influences the economic and political role of the United States as well as the relationship with other oil providing countries. By decreasing the number of private cars, traffic periods during commute times will also decrease along with money spend on providing gasoline each year. Katzev supports the idea of carsharing by discussing a wide variety of environmental, economic, and social issues that could be mediated by adopting the program. Oil spills, traffic and car fatalities, stress, and pollution will decline as benefits of carsaring. As a result, public transit and other transportation modes like walking and biking will increase, leading to a reshape in the landscape of the surrounding urban environment through cutbacks in highways, parking spaces, and service facilities for vehicle demands.

Schwieterman and Bieszcat (2017) explain the economic benefits when discussing the cost to carshare. Carsharing has become one of the most affordable solutions to urban

commuters while also make efforts to achieve sustainability goals. Base rates for an hour of basic carshare programs between 2011 and 2016 shows a 5 percent drop in cost, and an 11.2 percent reduction adjusted with inflation. Further research also indicates reductions in greenhouse gas emissions, pollution and traffic congestion through decreases in privately owned automobiles. Reductions in cost is seen through a decrease in money spent mitigating greenhouse gas pollution and costs in gasoline lost in traffic tie-ups. Parking costs and tickets diminish due to designated parking spaces for carshare vehicles as well as a shrink in stress as less cars are on the road taking up parking spaces. Carsharing is also researched and shown to promote active lifestyles as more people walk and bike to parking areas. There is an also indicated of encouraging an active lifestyle as users use the program only when necessary.

A recent report prepared by the Southwest Region Planning Commission (SWRPC) for the Monadnock Alliance for Sustainable Transportation (MAST) presented carsharing as an alternative to private vehicle ownership (SWRPC 2017). An overview of the carsharing program in Keene and the Monadnock region is provided as a way to fully understand the present stage of carsharing development. Carsharing is presented as a benefit through the ability of accessing a car without the ownership stress of a private vehicle. Stress on an individual is significantly reduced as the amount of money and time spent on repairing, maintaining, insuring, and cleaning a private vehicle is completely cut from the life of an individual. Stress levels also decrease as individuals naturally make more time for physical activity when commuting through walking and biking to get to carshare locations. The SWRPC report notes that studies indicate an increase in active transportation as more members choose to use a car for long trips or when necessary. The carshare programs also prove to be beneficial to families with low incomes by providing an

affordable mobility option. Low income families or individuals are able to travel or access different portions of their town they normally could not due to their inability to afford a private car. A decrease in the dependence of privately owned vehicles is briefly discussed as a result of carsharing. It is shown to have an increase in vehicle miles travelled per individual/family while also encouraging less driving. The program is highly recommended as a more attractive transportation option in a town that supports the higher education institute of Keene State College. This is accomplished by providing transportation for young college students, especially those that are out of state and must drive to work.

Challenges

Carsharing addresses challenges that are similar to typical problems of owning a car. These include; maintaining insurance coverage, vehicle inspection, repair costs, and arranging permanent parking. A private car is usually available to its owner, but there is no "promise" to carsharing customers that a car will be available where and when it is needed. However, with the addition of staff that most operators have, consumers can have help being redirected to the next best car option if their reserved car is deemed unavailable.

Owning a private car also has its benefits when it comes to car damage. They have the choice of fixing any cosmetic damage or not, while carshare customers have to be a little more detail-oriented. Depending on the carshare operation, users are required to check the carshare vehicle for damage before they use it. If they do not report the damage, they are usually liable for any repair costs. Reserving carshare time can also be a challenge for the customer in certain cases where they do not use all the time they reserved, and still have to pay the unused time, or have to pay extra for not returning the vehicle on time (Le Vine 2014).

An hourly or mileage-based fee has to be considered when carsharing. Some operators have a pre-set number of miles for each hour of usage. This can be a pro or a con depending on how much the customer is planning on driving. Other operators charge time and mileage separately. An example is City CarShare, they charge for usage by the hour and the mile. Rates are based on usage, but the mileage fee is commonly disliked among members. Longer trips are not as cost effective this way for the customers. (Sullivan and Magid 2014).

NFP (not for profit) carshares are faced with the challenge of start-up costs. These include; the shared vehicles, parking spaces, and the cost of marketing a new service to the public. Fundraising and financial assistance from the government and other agencies can help with these costs (Veichnicki 2015). Once an organization is up and running, decision making is a vital process that can lead to a successful carshare business, but also additional challenges. Opening a new pod, or adding a new vehicle to an existing pod takes planning. A dense network of pods will be more competitive against rental cars and modes of private transportation. Nonprofit and cooperative car-sharing organizations often rely on volunteer labor for a successful business. A critical challenge of organizations is making good volunteer connections and keeping their supporters happy. A successful carsharing business has to plan ahead and consider all the factors necessary to maintain carsharing convenience for their customers (City Carshare, n.d.).

Membership fees can be a deciding factor on whether a customer carshares with a certain organization or not. Charging a monthly or annual administrative fee is not uncommon. This fee allows overall usage rates to be kept lower and is beneficial for high-usage members. Members who only use the carshare occasionally, might be turned away from the program if the membership fee is too costly (Sullivan and Magid 2014). Introducing a Business to Consumer

(B2C) model carshare to a community or college campus has its own set of challenges as well. Certain companies, like ZipCar, require criteria to be met before they will enter into contract. Projected usage rates must be met, and if the revenue made is less than the cost of the cars, the college or community would have to pay the difference. B2C carshares also have to arrange for permanent parking within the college campus or community, which can result in additional costs (Walker 2013).

Ridesharing

Demographics

A study on high-occupancy vehicle (HOV) lanes and managed-lane use in Texas identifies three classes of characteristics that are used to define carpooling behaviors and trends – traveler characteristics, trip type characteristics, and an 'other' category that includes data like individual attitudes and perceived social and environmental benefits (Li, Embry, Mattingly, Sadabadi, Rasmidatta, and Burris 2007). All three categories influence what factors are important when it comes to why people choose to carpool.

Traveler characteristics include gender, age, marital status with or without children, and income. According to Li et al. (2017), 75 percent of carpoolers surveyed are classified as 'fampools', where the passengers are either adult family members or children. The second highest group of carpoolers is made up of coworkers at 26 percent, followed by casual and neighborhood carpools at four percent. The remaining nine percent includes roommates, boyfriends/girlfriends, and housemates. Women carpool more often than men, partly because of gender differences in family roles and travel patterns (Erdoğan, Cirillo, and Tremblay 2015; Li et al. 2007). However, while women make up the majority of riders in carpools, men make up

the majority of drivers (Tahmasseby, Kattan, and Barbour 2016). Household type also has a significant impact on carpooling rates, where studies show that families with children are more likely to carpool than married couples without children (Li et al. 2007). This trend becomes even more pronounced in carpools with three or more passengers. Additionally, several studies show that low income individuals and families are more likely to carpool (Li et al. 2007; Erdoğan et al. 2015; Tahmasseby et al. 2016). There are also carpooling trends related to age, where young millennials under the age of 25 are significantly more likely to carpool than any other age group (Tahmasseby et al. 2016).

Trip type characteristics differentiate between commute and work-related trips, recreational trips, and school trips. Commute trips include travel to work from home and back, and work-related trips include any travel done during the workday outside of the regular commute. School trips often involve transporting children to and from school, and can usually be classified as fampools. One study claims that carpooling is significantly more common for recreational trips than commute or work-related trips (Li et al. 2007). The same study discussed how people that carpool for different trip types rate influencing factors differently. For example, a person using a carpool for their daily commute values access to HOV lanes and the associated time-savings higher than the social benefits of carpooling.

The final 'other' classification deals with any other defining attributes that might encourage a person to choose to carpool. Occupation and work schedule are two of the factors that have the largest influence on transportation mode choice. For example, students and unemployed adults are more likely to carpool than people with full-time jobs. Several studies claim that flexible work hours also have a significant impact on employee carpool rates (Erdoğan

et al. 2015; Tahmasseby et al. 2016). Additionally, individual attitude and perceived social and environmental benefits also have a strong influence on potential carpoolers (Li et al. 2007).

Benefits

Ridesharing has been shown to have a direct connection to environmental benefits. Erdoğan, Cirillo and Tremblay (2013) depict this connection by discussing ridesharing as a green commute alternative through a campus case study. The authors discuss the demand for ridesharing in a campus context, aiming to provide programs for reducing carbon intensive travel options. Ridesharing is show as the greenest motorized transportation method in urban areas through the Federal Transit Administration (FTA). By expanding rideshare programs nation-wide, greenhouse gas emission problems are effectively tackled. Commuter survey data and models are generated and analyzed to understand the interest of participants implementing ridesharing. Benefits to ridesharing are discusses as a way to reduce environmental damage while also encouraging social interaction between college students. College towns will also benefit from the program as less traffic periods and tie-ups will occur with less individual driving college students.

Chan and Shaheen (2011) analyze the history of ridesharing in North America over multiple decades. The phases of rideshare evolution is categorized into World War II car-sharing, energy crisis in 1970, early ridesharing programs, reliable ride share programs, and technology made ridesharing programs. Through the study of these phases, ridesharing is shown to reduce the number of vehicles needed to travel, and vehicles on the road at a time. Societal benefits are shown through a decrease in vehicle repair, maintained services and social interaction. Attitudes and behaviors toward driving change as traffic congestion and time for travel decrease. Carpool

and van pool members are also seeing cost savings through shared travel costs, reduced stress due to less traffic congestion, and incentives such as favored parking locations. By implementing the rideshare program, societies can enact policies to most effectively and strategically reduce energy consumption. Recent ridesharing statistics are shared through the 638 ridematching programs in the United States and Canada and evaluated to predict the future success and uncertainty of ridesharing over the next decade. However, the growth of such a program is predicted to be a factor in combating climate change, traffic congestion, oil dependency, and stress issues of individuals.

Li et al. (2007) analyzes the specific audience ridesharing has attracted. The reasons why people choose to rideshare is evaluated by studying characteristics and reasons for their travel choice. The results show that social interactions with others while driving, environmental and social reasons, time saving, and vehicle costs are the most important factors for why individuals choose to participate in ridesharing programs. By starting the rideshare program, an increase of social interaction, and therefore, wellbeing is established and beneficial for individuals. Environmental issues are tackled as less cars on the road emit air and noise pollution. In fact, environmental considerations were important to about 80 percent of those surveyed in this study.

Zaman and Habib (2011) discuss the status of travel demand in Edmonton, Alberta. An evaluation of the city of Edmonton is conducted to assess the importance of establishing effective Travel Demand Management (TDM) policies. Travel behavior is analyzed to create a way in which the population can be influenced to reduce car use and embrace sustainable forms of transportation. Transportation is reported as the cause of 14 percent of greenhouse gas

emissions. Therefore, a decrease of cars on the road is seen as a necessary action for obtaining a green and sustainable future. Achieving sustainability in transportation is considered to effectively manage traffic congestion and combat negative environmental forces, while still giving individuals vehicle and mobility access.

Challenges

There are many challenges associated with ridesharing. Three main reasons for not partaking are; difficulty finding someone with the same location and schedule, needing a vehicle during the day, and the preferred flexibility of driving alone. Rideshare arrangements often fall apart due to a lack of schedule flexibility. Both the driver and passengers must agree on arrival and departure times, as well as meeting locations and other responsibilities. Work schedules and other errands can make ridesharing less convenient (Amey 2011). Transaction costs are also important factors when considering if ridesharing is right for an individual. One of these costs is the additional time needed to pick up and drop off passengers. Study results have shown that it is an inconvenience to have more than a 10-minute delay to pick up and drop off passengers. This is a crucial factor when considering carpooling with other people. Another transaction cost is the time that it takes to establish a rideshare arrangement. It can be time consuming to create a profile and search for rideshare matches, as well as the additional time it takes to create a carpooling schedule. A successful rideshare has minimal time commitments and is convenient for all the people involved (Amey 2011).

According to a carpooling survey, other reasons people choose not to rideshare include; potential partners might have disagreeable traits and needing to make other stops during the trip (Li et al. 2007). Potential partners having disagreeable traits is a common concern among

carpoolers. Drivers and passengers that want to share rides might not be aware of having ways to identify each other. Even with ride matching systems, there is still little known about individuals themselves. The drivers driving history, and if they smoke are two common questions that without the information can deter someone from carpooling (Amey 2011). Ridesharing most commonly takes place between neighbors, family members and co-workers. This is due to the challenge of unknown travelers and potentially dangerous situations. Personal safety concerns are a big factor to consider when deciding to rideshare with a stranger. This leads into the possible technological challenges a person might have when considering to rideshare or not. Not being able to obtain the right technology to use and find a suitable rideshare match can deter a participant. Another technological challenge is creating a common data specification to transmit and store the rideshare information (Amey 2011). Without a successful and safe database, rideshare members will find the service less convenient.

Rideshare incentives can make or break the long-term use and goal of ridesharing. A method for measuring successful rideshare trips needs to be carefully created. This will make sure that the participants are rewarded for taking a rideshare trip and that employers can determine if their rideshare initiatives are effective. Current systems right now lack a high investment in rideshare initiatives. Rideshare service provider's also have the challenge and competition of generating the best revenue from a rideshare arrangement. Providers rely on advertising and marketing to generate a big portion of any money. Successful initiatives through advertising are key to a successful rideshare company.

Carpooling becomes challenging if there are not adequate "park and ride" spots available. Big store parking lots often work as a means of informal carpooling lots. If the carpooling

participants are meeting and taking one car, the car(s) left behind ideally need to be safe from the chance of a ticket or being towed. Potential lots designated for carpooling can be identified and proposed, as well as the use of existing park and ride lots (Amey 2011). If the challenges of rideshare can be overcome and the needs of the carpooling participants can be met, a successful, convenient system can be created.

Public Transportation

Demographics

Studies suggest that public transportation ridership depends heavily on passenger demographics such as age, gender, ethnicity, and income (Lou, Cau, Mulligan, and Li 2016; Neff and Pham 2007; Yazdanpnah and Hosseinlou 2016). One of these studies analyzes data scraped from geo-tagged twitter feeds and finds that race and ethnicity has the most significant impact on human mobility patterns (Lou et. al. 2016). According to a report prepared by John Neff and Larry Pham (2007) for the American Public Transportation Association (APTA), 40.6 percent of passengers are White/Caucasian, followed by Black/African American at 33.1 percent, Hispanic/Latino at 14.3 percent, Asian/Pacific Islander at 5.5 percent, and 6.6 percent multi-ethnic/other (Figure 2.1). Comparing these numbers to Census Bureau statistics on race in the United States suggests that other factors have an impact as well, since the difference between data sets is dramatic (Figure 2.2). For example, Black/African American people make up 33.1 percent of the total ridership, but only 13.3% of the total population. The APTA report also mentions that 59 percent of passengers are adults between 25 and 54 years of age, which is consistent with a 2016 study that claims that public transportation use increases with age (Yazdanpanah and Hosseinlou 2016).

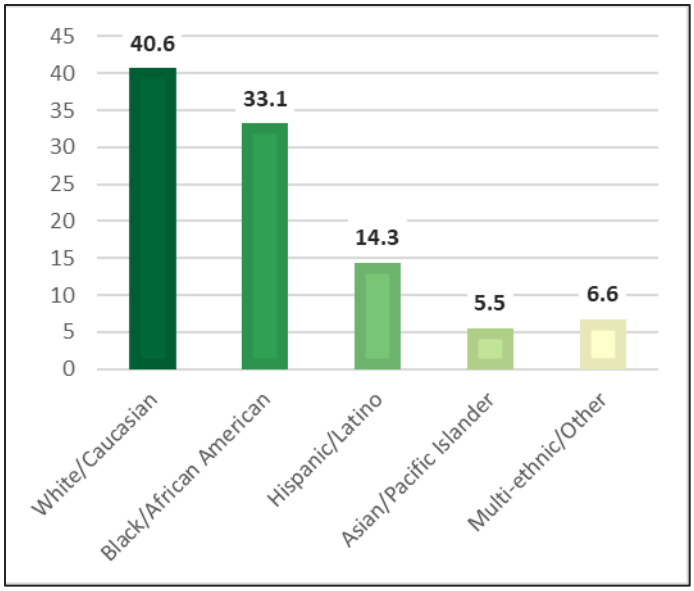


Figure 2.1: *Public transportation ridership by race/ethnicity. Data source: Neff and Pham (2007). Created by Lisa Donnelly.*

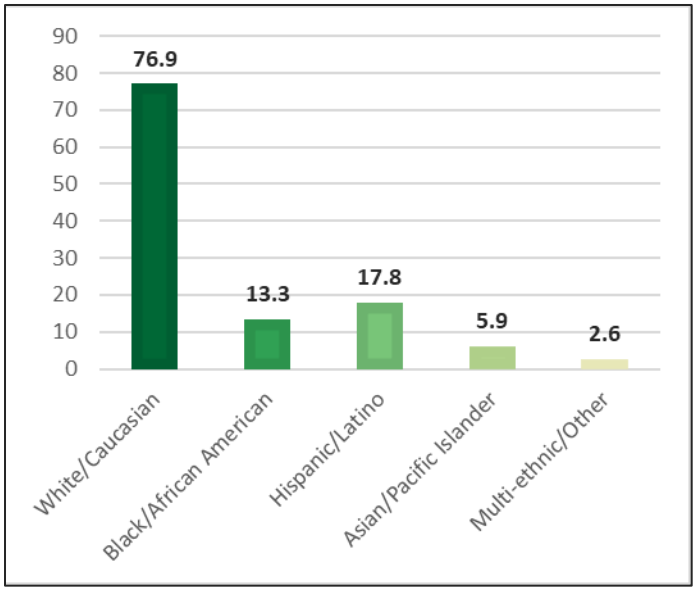


Figure 2.2: United States population by race/ethnicity. Data source: United States Census Bureau 2016 estimates. Created by Lisa Donnelly.

Most public transportation passengers are employed, and the majority of trips are work-related commutes (Neff and Pham 2007). A much smaller number of riders are students, followed by the unemployed, retired, and homemakers. The APTA report goes on to state that

just under one third of passengers are carless, and that the median income of passengers is less than 39,000. In 2012, a study was conducted on the transportation disadvantaged in Syracuse, New York that identifies the elderly, disabled, and poor as vulnerable populations that are heavily dependent on public transportation (Attoh 2012). The study claims that only five percent of welfare recipients in the city have access to a car, and that a lack of mobility options limits access to jobs and other resources.

Benefits

In the current day and age, public transit has taken a backseat as privately-owned cars have gained more popularity, due to affordability. Anderson (2013) provides many environmental and economic benefits from the existence of public transportation. Public transportation accounts for only 1% of traveled miles in the United States, however, maintains strong public support. Although public transportation is not a first choice for many, readily available transportation systems are supported by the public as a secondary choice to private transportation. In this study, Anderson found a 47% increase in highway congestion and delays when there is an issue in public transit. Anderson concluded his study by determining a benefit from reduced traffic congestion even if commuters use public transit systems rarely.

In a recent report, Litman (2017) discussed the economic, social, and environmental benefits of public transportation. Economic reasons included a decrease in development and public service costs. With an increase in public transportation, Litman indicates a reduction in amount of land paved for parking facilities. Other economic benefits include, consumer transportation cost savings and more efficient transportation. A decrease in parking facilities can lead to environmental benefits such as more conserved greenspace, parks and wildlife habitats.

Environmental benefits also include a reduction in air pollution, resource consumption, and water pollution as less people are driving privately owned vehicles. Social benefits included a developed sense of community a transportation access for those who are non-drivers. Overall, public transportation systems provided an easily accessible transportation option for a society while so encouraging a communal and environmental atmosphere.

Challenges

Public transit systems and transportation face a multitude of challenges; social, economic, and technical. Development, restoration, and improvement has been initiated around the world to meet the growing transportation needs (Kaewunruen 2016). This leads to system performance not always being reliable. Unplanned events and delays lead to a non-resilient transportation system. Extreme weather conditions and crashes often create traffic congestion (Butler 2013).

There is a high turnover rate of technical staff worldwide in the transportation industry, and incidents have repeated themselves. This leads to service delays and cancelations, as well as high maintenance costs. Successful management and route monitoring is a challenge that can lead to societal consequences, like the loss of lives (Kaewunruen 2016). The connectivity of public transit systems can also be a concern for the riders. Most are independent, like the bus, the subway, the rail. Transferring passengers from one to another cause time conflicts and may be inconvenient for passengers that don't need to transfer between systems (Rodrigue 2013).

Making the customers aware that new routes and bus systems are available is key to a successful system. As well as marketing, meeting the needs and requirements of urban mobility is another challenge. Parking difficulties and congestion are an on-going problem in many large urban areas. These two problems are interconnected, because people looking for parking spots

often cause traffic congestion themselves. Increased commuting time is another challenge, and may deter people from taking public transportation modes like the bus. If they can get to work faster in their own car and without the crowdedness and constant stops, it can be more convenient than the public system (Rodrigue 2013).

Carshare, rideshare and public transportation all have benefits and challenges associated with them. Carshare, as a growing industry, is most common among people who use public transportation or who are likely walk. Rideshare, most commonly used among families and co-workers, offers environmental benefits as well as money saving incentives. Public transportation provides many work commuters a ride to their job, as well as minimizes traffic congestion. All three forms of alternative transportation are used and relied upon by various different groups.

Chapter 3

Background

The mountainous state of New Hampshire is made up of 10 counties, 13 cities, 221 towns, and 25 unincorporated places. This chapter defines the area of study, and explores the physical and human geography, economic development, and the green ethos of New Hampshire. It also introduces how improving and expanding mobility options will make transportation more equitable and sustainable within the Southwest Region.

The state of New Hampshire is divided into nine regions by the New Hampshire Association of Regional Planning Commissions (NHARPC). Each region has its own planning commission that is responsible for meeting the development, housing, and transportation needs of the municipalities and counties local to each region (New Hampshire General Court 2004). The NHARPC coordinates and supports the activities of the planning commissions on a statewide level, while maintaining relationships with federal and state agencies. The Southwest Region Planning Commission (SWRPC) is responsible for all of Cheshire County, ten towns in Hillsborough County, and one town in Sullivan County (Figure 3.1). In working in conjunction with the SWRPC, this project will focus on the southwest region as defined by the NHARPC, with additional detailed research and analysis of the City of Keene.

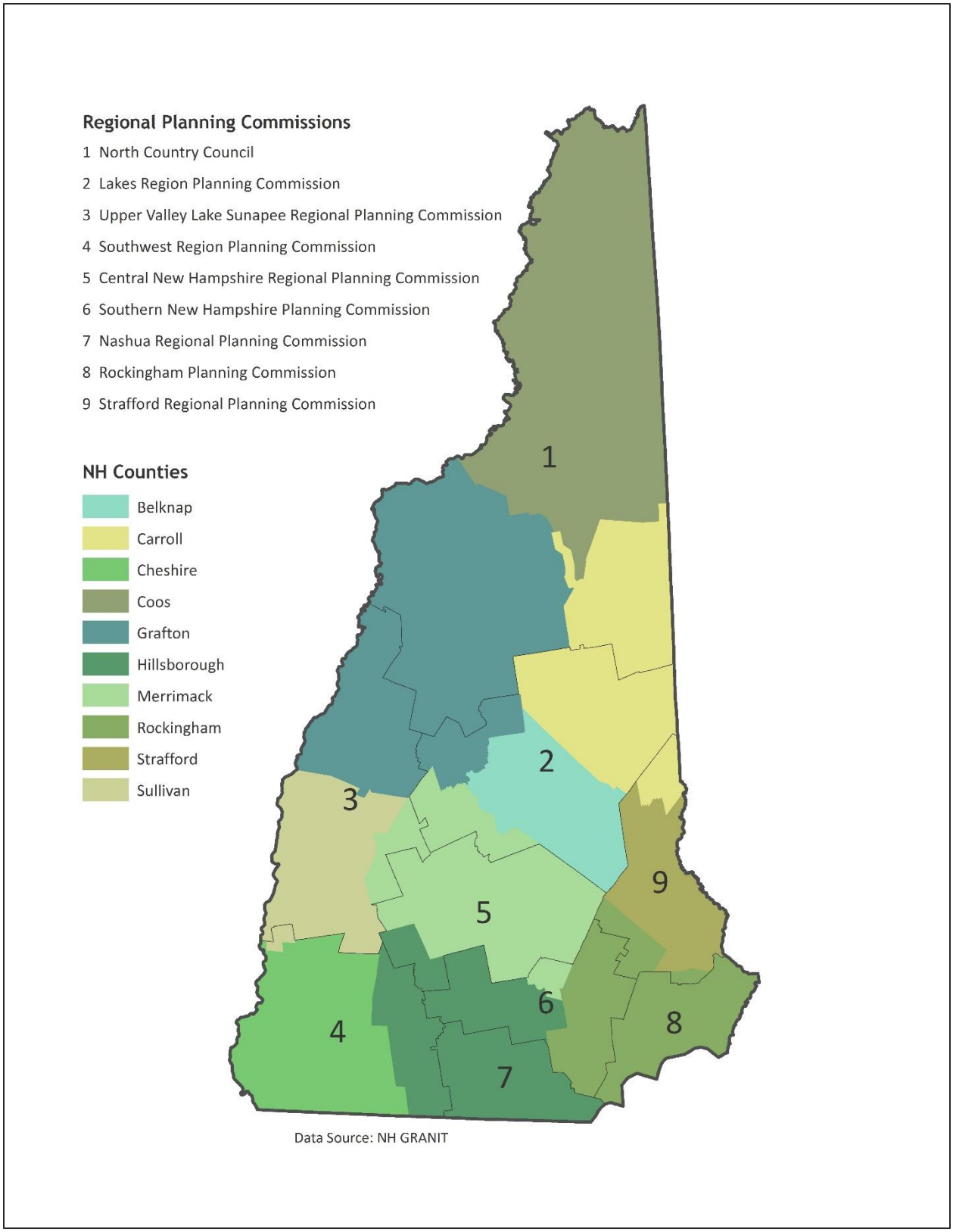


Figure 3.1: *New Hampshire planning commissions and counties. Created by Lisa Donnelly.*

Geography

New Hampshire is located in the northeast region of the United States, where it is bordered by the province of Quebec in Canada to the north, Maine and an 18 mile stretch of the Atlantic Ocean to the east, Massachusetts to the south, and Vermont and the Connecticut River to the west. It is one of the smallest states in the country at 9,349 square miles (USGS no date). The state is most well-known for its impressive scenery, including glacier-carved mountains and lakes; particularly for Mount Washington of the White Mountains in the north, Mount Monadnock in the southwest, and Lake Winnipesaukee. Most of New Hampshire is forested land, which supports a wide variety of flora and fauna.

The Köppen-Geiger classification system labels most of the state as humid continental with warm to hot summers and cold winters. Precipitation in the area is relatively even throughout the year, with no distinct dry or rainy seasons (Figure 3.2). However, the climate in New Hampshire varies dramatically from region to region due to differences in elevation, latitude, proximity to the ocean, and topography. For example, the mountainous northern regions of the state are heavily influenced by elevation and the movement of cold and dry air from sub-arctic North America, and the coastal areas are influenced by warm and moist air from the Gulf Stream. The topography of the state creates distinct regions defined by mountain ranges, river valleys, and coastal areas.

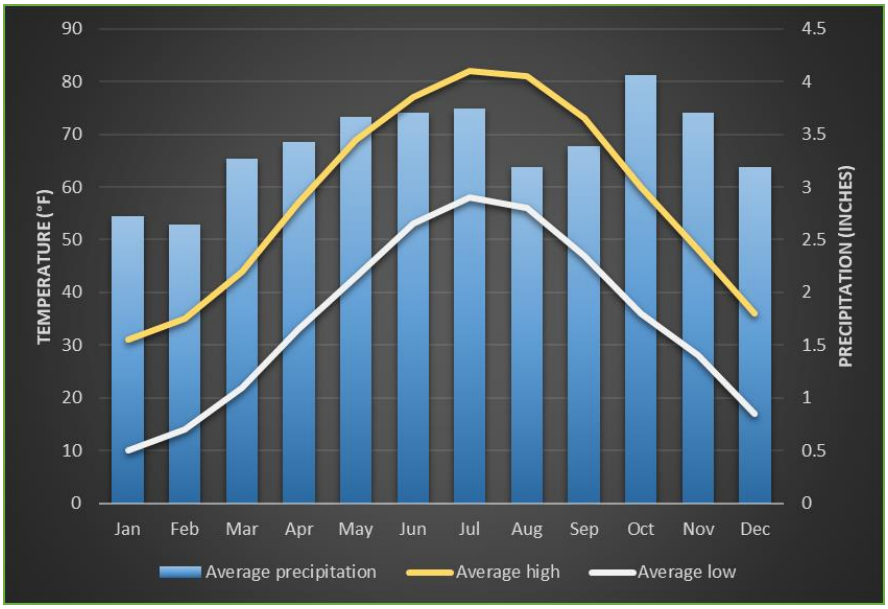


Figure 3.2: *Average precipitation and average high/low temperatures in New Hampshire. Data source: NOAA. Created by Lisa Donnelly.*

The population of the southwest region is approximately 100,438, with slightly more women than men. In a population pyramid created using 2016 American Community Survey (ACS) data, the population distribution by age group suggests some apparent trends (Figure 3.3). Relatively few children are being born, and the number of adults of childbearing age is also relatively low, which indicates that people are choosing to migrate out of the area upon reaching adulthood or after graduation. The noticeable surge of young men and women in their late teens is indicative of the student population in the area, which supports the theory that there is a steady outmigration of millennials. There is also a substantial number of older adults whose needs will have to be met as they continue to age, which creates additional challenges for the region including health care costs and mobility issues.

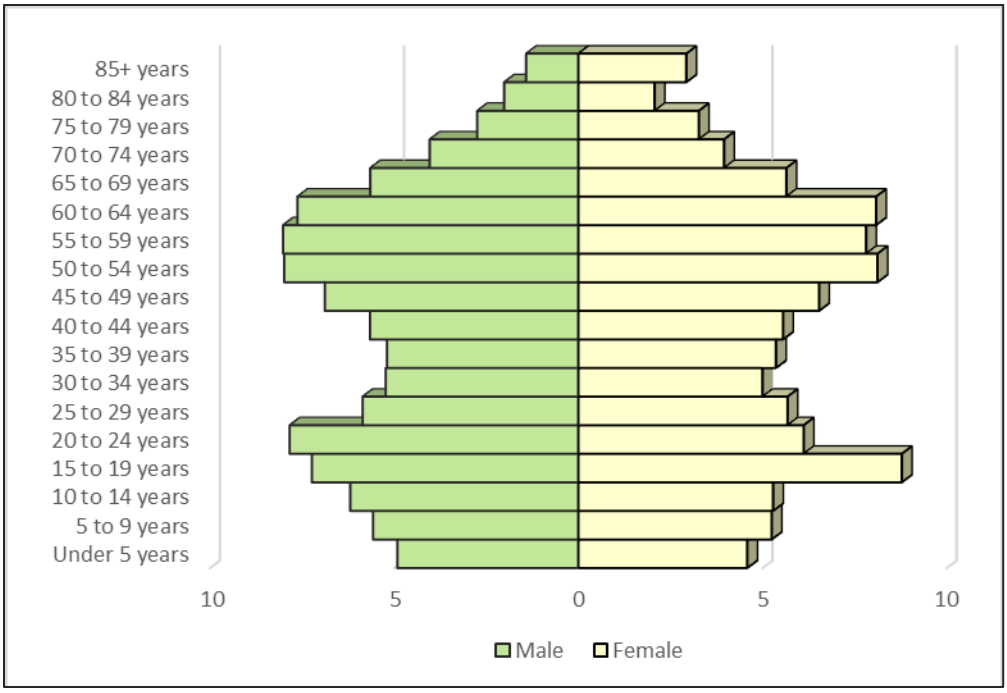


Figure 3.3: Southwest Region Population Pyramid. Data source: American Community Survey. Created by Lisa Donnelly.

Nearly one fourth of the total population in the region lives in Keene, with a similar ratio of men to women. Using ACS data to create a population pyramid produces similar but even more drastic result (Figure 3.4). The surge in college-aged young adults is evident, followed by an immediate drop in population in the 25 to 29 age group. Since most students at Keene State College are aged 18 to 24, this suggests that most of the students choose to move out of the region after graduation. Taking steps to retain educated millennials after graduation, and to attract them from other areas, would give Keene and the greater Monadnock region an economic boost. Improving and expanding mobility options is one way to accomplish that while meeting the needs of low income individuals and families.

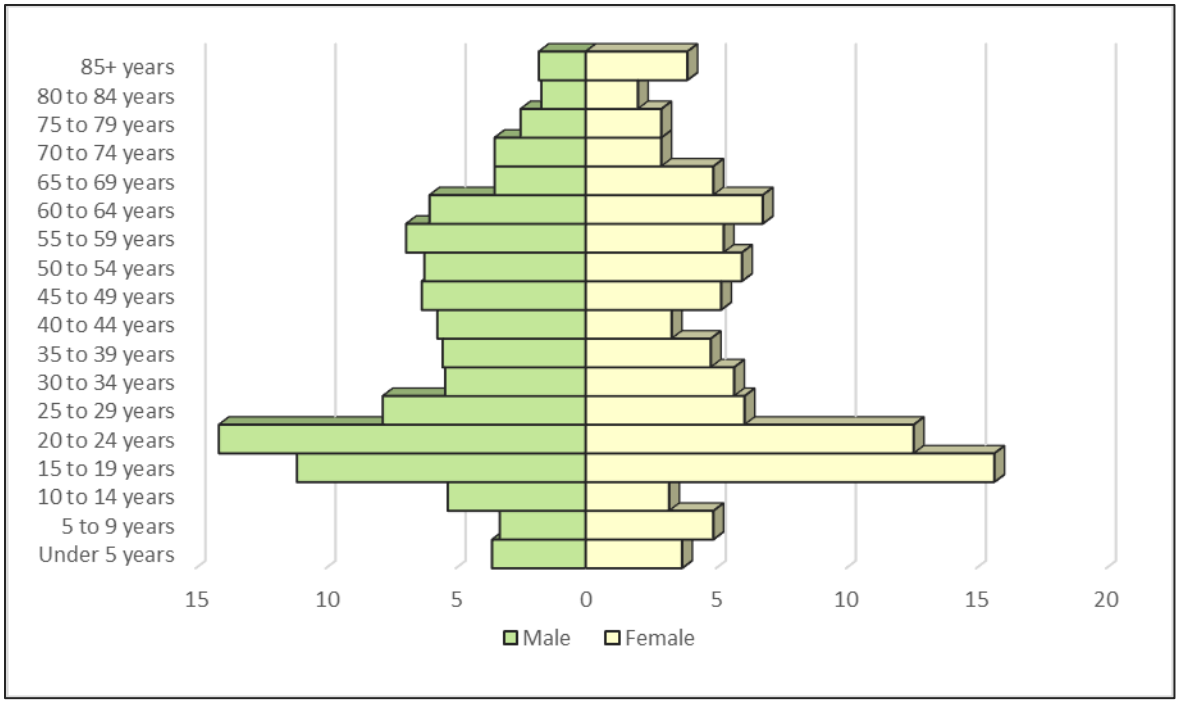


Figure 3.4: Southwest Region population pyramid. Data source: American Community Survey. Created by Lisa Donnelly.

Major Employers

With a population of over 23,000 people, the City of Keene has a wide array of businesses. The top ten largest businesses by their number of employees is shown in Table 3.1. These products and services include; health care, wholesale foods, education, hospital supplies, industrial marking equipment, insurance, mini & precision bearings, and precision infrared optics. The average number of employees working at these ten businesses is about 675 employees (New Hampshire Employment Security 2017).

Table 3.1: *Largest businesses in Keene, New Hampshire (New Hampshire Employment Security 2017). Created by Aimee Krafft.*

Largest Businesses	*# of Employees*
Cheshire Medical Center/Dartmouth Hitchcock	1,500
C & S Wholesale Grocers	1,200
Keene School District	1,198
Keene State College	933
Smith Industrial Medical Systems	480
Markem Imaje Corporation	400
Liberty Mutual/Peerless Insurance Company	354
National Grange Mutual Insurance	347
TimKen Super Precision	262
Janos Technologies	70

The largest business, Cheshire Medical Center/Dartmouth Hitchcock center has 1,500 employees. The nonprofit center provides surgical services and acute impatient care, as well as primary care and specialty medicine (Figure 3.5). The primary care department provided over 151,000 patient visits in the 2015-2016 year, and has plans to increase this number in the years to come (Cheshire Medical Center/Dartmouth - Hitchcock 2017). Keene's aging population connects with a need for transportation to the medical center. Bus transportation, such as the City Express, provides a stop at the hospital's entrance.

Figure 3.5: *Cheshire Medical Center main entrance sign. Source: Aimee Krafft.*

As of January 2017, the City of Keene has a labor force of 12,030 people. There are 11,680 people employed and 350 people unemployed. The unemployment rate in Keene is 2.8%.

Compared to other cities in New Hampshire, Keene has a slightly lower/same unemployment rate (Figure 3.6). Manchester and Nashua have a slightly higher unemployment rate than Keene. Rochester and Concord have slightly lower unemployment rates than Keene. The United States unemployment rate is 4.3%, which is notably higher than that of the City of Keene's rate. New Hampshire's unemployment rate is 2.8%, the same rate as Keene. (New Hampshire Local Area Statistics 2017).

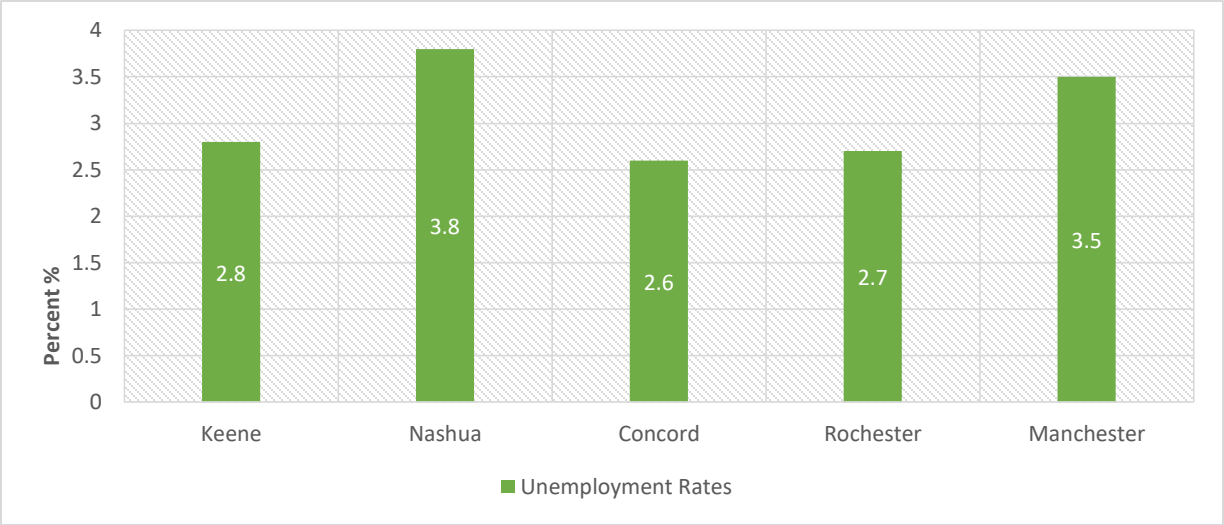


Figure 3.6: *Unemployment rates of five cities in New Hampshire. Data source: New Hampshire Local Area Statistics 2017. Created by Aimee Krafft.*

Per capita income in the City of Keene is $29,383. The United States per capita income of $28,930 and New Hampshire's per capita income is $34,362 dollars (Table 3.2). Keene has a lower per capita income than New Hampshire's but a relatively same/higher income than The United States. The median household income of Keene is $52,636. New Hampshire's median household income is $66,779, and the United States' median household income is $56,516. Keene has the smallest median household income between itself, New Hampshire and the United States (Table 3.2).

Table 3.2: *Per capita income of the United States, New Hampshire, and Keene. Data source: United States Census Bureau 2017. Created by Aimee Krafft.*

	Per Capita Income	*Median Household Income*
United States	$28,930	$56,516
New Hampshire	$34,362	$66,779
Keene	$29,383	$52,636

The City of Keene's median household income is $14,143 less than the state of New Hampshire's income. The city would benefit from having a rideshare system in place for residents who cannot afford their own car. The percent of people living below the poverty rate in Keene is 17%. A rideshare system would allow residents to plan ride schedules to and from work (and a variety of places) with other city residents, as well as save money. Residents would also benefit from the available City Express bus schedule in Keene.

Green Ethos

Over the last few decades, Keene has been actively working toward a sustainable community. Keene defines a sustainable community as one that develops while thinking of the balanced environmental, social, physical and economic considerations in city decision making (City of Keene 2010). In the past, Keene has worked toward a culture of sustainability through such measures as lower greenhouse gas emissions and expected impacts of climate change, transportation, green building, recreation spaces, and efforts from Keene State College. The Keene and Monadnock Region hopes their achievements can foster a long-term environmental, social, and economic community. Carshare, rideshare, and public transportation programs are just a natural outgrowth of an already impressive green ethos.

New Hampshire Climate Adaptation Action Plan

Climate action and protection has been an important element to the development of Keene. In April 2000, Keene agreed to the Cities for Climate Protection Campaign (CCP), a program overseen by the Local Governments for Sustainability (City of Keene 2007). When agreeing to the campaign, the City of Keene developed a Local Action Climate Plan focused on lowering the greenhouse gas emissions released by the greater Keene community. In 2007, their efforts in addressing climate change named them one of the first communities in the country to create a climate change adaptation plan.

A greenhouse gas emissions (GHG) inventory was created in 2000 to establish two targets including: 1) A 10 percent reduction below 1995 levels of GHGs for the community, 2) A 20 percent reduction in GHGs from municipal emissions. With these goals achieved, the CCP committee, developed, implemented, and ensured the City of Keene would achieve the goal of an 80 percent reduction below 1995 levels by 2050 (City of Keene 2010). Emissions in 1995 totaled 204,529 tons of carbon dioxide equivalent (CO_2e) and were estimated to decrease to 184,076 tons of CO_2e by 2015 due to a reduction goal of 10 percent (Figure 3.7) (City of Keene 2010). This commitment to climate change protection and climate change adaptation has reduced the amount of negative environmental forces threatening the city. These past climate induced forces include severe flooding, snowfall changes, non-native plant and animal species infestation, days with poor air quality, and number of high heat index days (City of Keene 2007). In the first decade of the millennium, the city enacted 67 different actions including building electric generation, carbon sequestration, transportation, and more (City of Keene 2010).

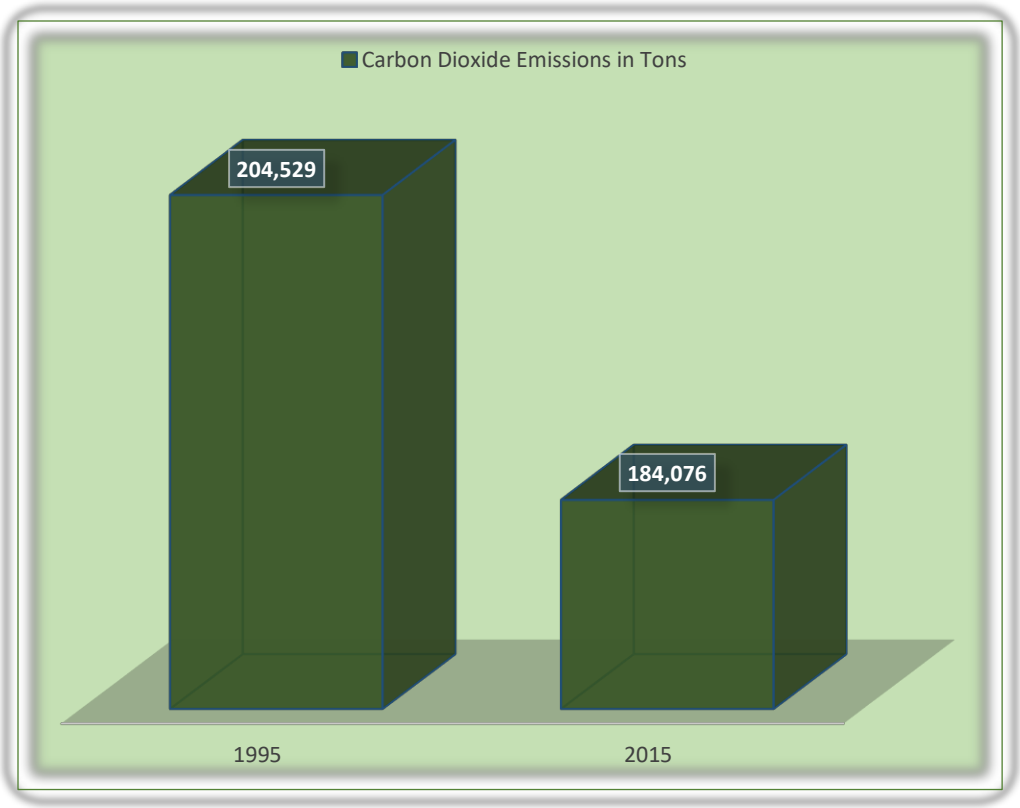


Figure 3.7: *The amount of CO_2e emitted in 1995 compared to the amount emitted in 2015, after a 10% reduction goal (City of Keene 2010). Created by Gabriela Pacheco.*

Green Buildings

In 2010, nearly 48 percent of total emissions derived from residential and commercial buildings (City of Keene 2010). As a way to shift and decrease the carbon footprint of the area, changes in where buildings are located and how they are built have been rethought and designed. High standards for building procedures have been retrofitted for sustainable designed and use. An example is the Monadnock Food Co-op, a community owned business working to educate shoppers of the existing local farmers in the region. The building installed compressor water heaters, LED lighting, solar panels, and a waste program (Figure 3.8) (Monadnock Food Co-op 2017).

Keene has also changed its procedure for renovated or refitted buildings to be designed to last more than 100 years using materials that produce the least negative environmental and economic impacts. These sustainable materials are locally harvested or obtained for closer regions, rather than outsources from areas across the nation. Recycled and reclaimed materials have also been encouraging public and privately designed and manufactured homes or buildings (City of Keene 2010).

Figure 3.8: *Monadnock Food Co-op located in downtown Keene, New Hampshire. Photo source: Gabriela Pacheco.*

Transportation

The City of Keene was designed in a radial and grid pattern in which Central Square was linked to outlying communities. Toward the end of the nineteenth century, Keene managed four railroad systems; Cheshire Branch, the Ashuelot Railroad, the Manchester and Keene Railroad,

and the Connecticut River Railroad. With a switch from railroad to privately owned vehicles, public transportation soon lost its popularity. Following such events, convenient means to travel to and from Keene via public transportation became nonexistent (City of Keene 2010).

In the past, low levels of development and rate of population growth has indicated an underwhelming demand of public transportation. In the City of Keene, the City Express, administered by the Home Healthcare, Hospice and Community Services organization, has been the only form of public transportation over the last few years. In the last decade, ridership for the service was not overly large and averaged 140 rides per day and no more than 52,845 riders annually (Table 3.3) (City of Keene 2010). However, with low membership at the time, the City Express provided a system that encouraged community and sustainable living and commuting.

Table 3.3: *Total City Express ridership by year from 2003 through 2016 (Home Healthcare Hospice & Community Services and City of Keene 2010). Created by Gabriela Pacheco.*

Year of Service	**Total Ridership**
2003	28,362
2004	29,468
2005	33,343
2006	31,413
2007	40,345
2008	50,010
2009	52,845
2010	44,998
2011	43,021
2012	45,795
2013	42,995
2014	40,125
2015	44,675
2016	36,769

Recreational Resources, Trails and Conservation Land

As a city that encourages a sustainable future and passion for the outdoors, Keene has acquired 2,000 acres of recreation land managed by the Keene Parks and Recreation Department. This includes about 16 miles of trails which includes a network of trails spanning across the Monadnock Region. The City of Keene has also maintained 1,900 acres of land reserved for conservation and 2,400 acres of land protected by conservation easements (City of Keene 2010). As a way to encourage green spaces, the city has worked to keep and expand these protected lands.

Keene State College

Keene State College has long held a strong and committed promise to environmental sustainability. Green efforts include promoting and fostering a green culture to improve the quality of life for not only students but for the greater Keene community. Over the last decade, Keene State College has held a program of students, Eco-Reps, working to promote a sustainable campus and society (Figure 3.9). Their job has been to maintain and generate a culture of sustainability through education and outreach for the Keene State College campus and greater Keene community (Sustainability at Keene State 2017). R.O.C.K.S, or Recycling On Campus at Keene State, is a program working to manage recycling on the college campus over the last decade (Figure 3.10). Both these student-run programs have established a green ethos at the college and is one of the first initiatives Keene State College has taken toward a sustainable future.

Figure 3.9: *Eco-reps, including Gabriela Pacheco (right) tabling for the Ban The Bottle Campaign. Photo source: Gabriela Pacheco.*

Figure 3.10: *R.O.C.K.S crew members working on composting the food scraps from the Zorn Dining Commons. Photo source: Gabriela Pacheco.*

To conclude, Keene, New Hampshire, has been heavily involved in the move toward a green community. Its efforts to generate a sustainable society is seen in its Climate Adaptation Action Plan developed in 2007, construction of green buildings, past transportation systems, recreation and conservation lands, and influence of sustainability in students at Keene State College. Through these past actions, Keene and the Monadnock Region will soon be on their way to a balanced environmental, social, and economic community. With the space for improvement in public transportation, carshare and rideshare programs will only push Keene further into a truly sustainable future.

Chapter 4

Current Trends

Carsharing in the Monadnock Region

Currently, the Monadnock Region does not have an established carshare program in the area. In the past, the Monadnock Alliance for Sustainable Transportation asked the Southwest Region Planning Commission to provide information on the feasibility an established carsharing program in the region. We will be using this study to research the potential of bringing a carshare operation to the City of Keene while also looking at established programs in other areas with similar transportation needs.

Carshare Vermont

Carshare Vermont is a local non-profit organization that offers an affordable and easy alternative to owning a car (Figure 4.1). The process is an online application followed by reserving a vehicle. Reservation includes choosing the vehicle and pickup location. Carshare Vermont promotes "you only pay for what you use" which entails all-inclusive rates that start at $6.00 an hour and $.35 per mile. Day rates are also available. Essentially, pay is based on how much is driven (Carshare Vermont 2016).

Figure 4.1: *Carshare VT parking space. Photo Source: CarshareVT.org 2017.*

Carshare Vermont is a member of the Carsharing Association, which is known as the "leading authority of the carsharing industry." The association was developed to provide an industry voice to support its members. The purpose of the association is to "support the sustainability and efficacy of the carsharing industry in order to meet financial, environmental and educational goals based on socially responsible ethics, standards and practices." The association was founded in 2011 and represents 25 carsharing organizations worldwide (Carshare Vermont 2016).

A Carshare Vermont case study at the High Meadows Fund Learning Event was conducted in 2011 with participants from various community businesses. Three questions addressed were:

- What would make Carshare Vermont's program important to your business's goals? (Table 4.1)
- What info/message bearers would most influence your thinking? (Table 4.2)
- What are possible barriers? (Table 4.3)

Table 4.1: *Case study question one. Data Source: Carshare Vermont Case Study. Created by: Aimee Krafft.*

What would make Carshare Vermont's program important to your business's goals?	
Cost Savings	Convenience for employees
Enhance Image	Support 'green' claims
Employee wellness	Recruitment and Retention
Save parking for customers/commerce	Manage parking demand
Company pride	Improved air quality for everyone

Table 4.2: *Case study question two. Data source: Carshare Vermont Case Study. Created by: Aimee Krafft.*

What info/message bearers would most influence your thinking?	
Clearly and quickly state what carsharing is and how it works	Showcase other businesses that saved money
Neighbors/community	Politicians, state gov.
Influence groups (e.g. Rotary Clubs)	Employee demand

Table 4.3: *Case study question three. Data source: Carshare Vermont Case Study. Created by: Aimee Krafft.*

What are possible barriers for a carshare program?	
Location of vehicles	Internal buy-in up and down chain of command
Lack of buy-in from decision-makers	Being able to monetize benefit
Not yet part of employee incentives	Car Availability

This case study and the three particular questions can be potential information/questions that would benefit Keene and the Southwest Region businesses as well. Addressing the question "What would make Carshare Vermont's program important to your business's goals?", businesses would generally have many similar and overarching thoughts such as cost savings, managing parking demand, and convenience for employees (Table 4.1).

Information from the question "What information/message bearers would most influence you thinking?" is valuable because Keene and the Southwest Region can benefit from these examples of influences (Table 4.2). To start the process of publicizing a carshare program, following these influences/communication ideas would be beneficial. The question "What are

possible barriers for a carshare program?" provides potential issues that should be brought to the forefront of a carshare decision making process. This case study is very beneficial to carshare planning in Keene and the Southwest Region, but also is a beneficial process for a potential carshare service at a college like Keene State.

Zipcar and Smith College Case Study

Carsharing organizations have increased across North America. One of the most popular carshare organizations, Zipcar, is on more than 400 campuses in the United States. Zipcar has and continues to provide colleges on-demand vehicles since 2000 (Zipcar 2017). Gavin Thomas, a junior at Keene State College, used a Zipcar for his first time after his car broke down hours from his apartment.

> My girlfriend rented a Zipcar for us to drive from UNH to Keene State College after my car broke down. It was really convenient to have another option of transportation. It is a useful tool for those in the UNH area without any transportation, and could be beneficial at Keene as well. (Thomas 2017, Personal Communication).

Zipcar would be beneficial to students who do not have their own car, or have unexpected car problems.

Smith College located in Northampton, Massachusetts, is comparable to Keene State College in Keene, New Hampshire. Smith College is a Liberal Arts College for women, and part of a Five College Consortium that offers joint courses and combined library catalogues. Mount Holyoke, Hampshire College, Amherst College, UMass Amherst, and Smith College are all part of the consortium. Comparable to Keene State College's campus of around 3,800 students, Smith College has about 3,000 students. The City of Northampton has a population of just under 29,000 people, and the City of Keene has a population of a little over 23,000 people (Serreze 2014).

The Zipcar program at Smith College has potential to represent the possibility of a similar program at Keene State College. Zipcar and Smith College partnered in 2006, with the intention to reduce traffic congestion. The campus started with two cars that Zipcar paid for at about $18,000 each. The program was successful, and another two cars were added to the fleet two years later. In 2014 the carsharing program was introduced to the larger community. Zipcar leased two municipal carshare parking spots in downtown Northampton from the city for about $1,200 per year (Serreze 2014). The City of Keene has an electric charging station and a parking spot designated for electric cars located downtown (Figure 4.2). A similar designation for carsharing parking spots like the City of Northampton would be beneficial in Keene.

Figure 4.2 *City of Keene electric car charging station and reserved parking spot. Photo source: Aimee Krafft.*

A study to determine a useful tool to assess the market potential for car-sharing in any neighborhood was conducted based on an analysis of 13 US regions. The study analyzed

neighborhood characteristics of existing car-share locations. Table 4.4 shows the thresholds for each low and high levels of service based on three categories: demographics, commute mode share, and vehicle ownership (Celsor 2006).

Table 4.4: *Carsharing thresholds (Celsor 2006). Created by Aimee Krafft.*

	Level of Service	
	Low	**High**
Demographics		
% 1-person households	30.00%	40%-50%
Commute Mode Share		
% drive alone to work	55.00%	35%-40%
% walk to work	5.00%	15%-20%
Vehicle Ownership		
% households with no vehicle	10%-15%	35%-40%
% households with 0 or 1 vehicle	60.00%	70-80%

Following these thresholds, focusing on the Southwest Region, seven towns meet the minimum threshold of 30 percent of one-person households. These towns include Harrisville, Jaffrey, Keene, Marlborough, Brattleboro, and Bellows Falls (Figure 4.3). Harrisville met the low level of service requirement with 30 percent, Jaffrey with 31 percent, and Keene with 33.1 percent having one-person households. Marlborough also met the low service requirement with 33.3 percent, Brattleboro with 33.4 percent, and Bellows Falls with the highest 39.3 percent of one-person households. One-person households are more common in carsharing neighborhoods, this information based this aspect of the study (Celsor 2006).

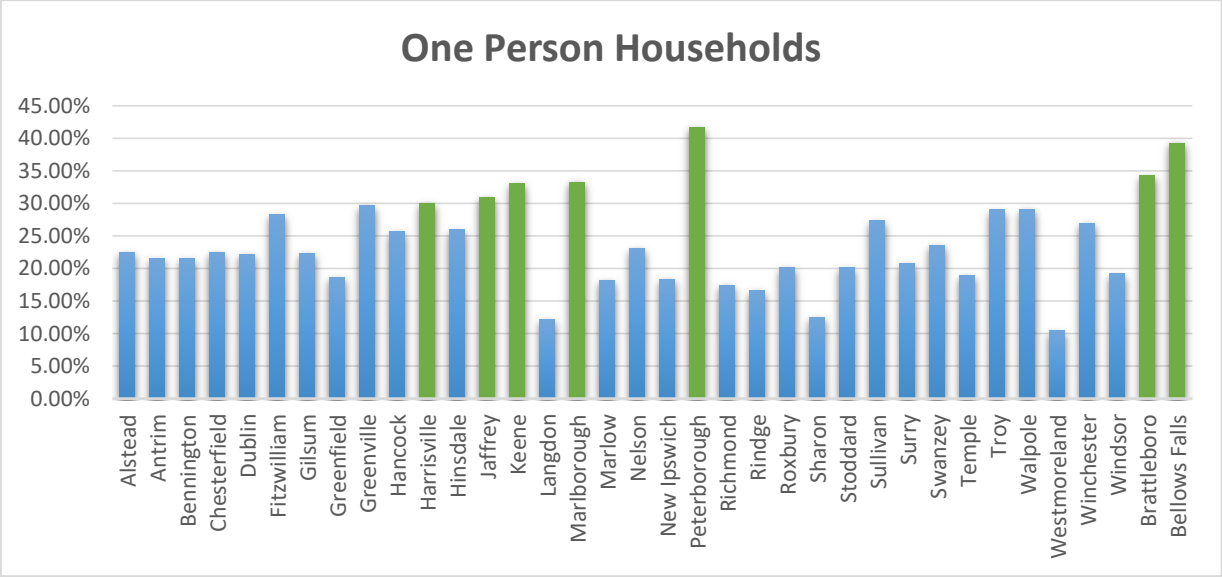


Figure 4.3: *One person household thresholds, areas in green meet the minimum requirement according to Celsor (2007). Data source: US Census Bureau. Created by: Lisa Donnelly.*

The threshold for the minimum low level of service requirement for vehicle ownership, focusing on households with no vehicles is 10-15%. Keene, Brattleboro, and Bellows Falls are the only three towns within the region that meet the low level of service requirement for this criterion (Figure 4.4). Bellows Falls meets the low-level service requirement of 60% for households with 0 or 1 vehicle as well. This criterion was based on the research that residents of car-sharing neighborhoods own fewer vehicles than the regional average, and are likely to live without a car.

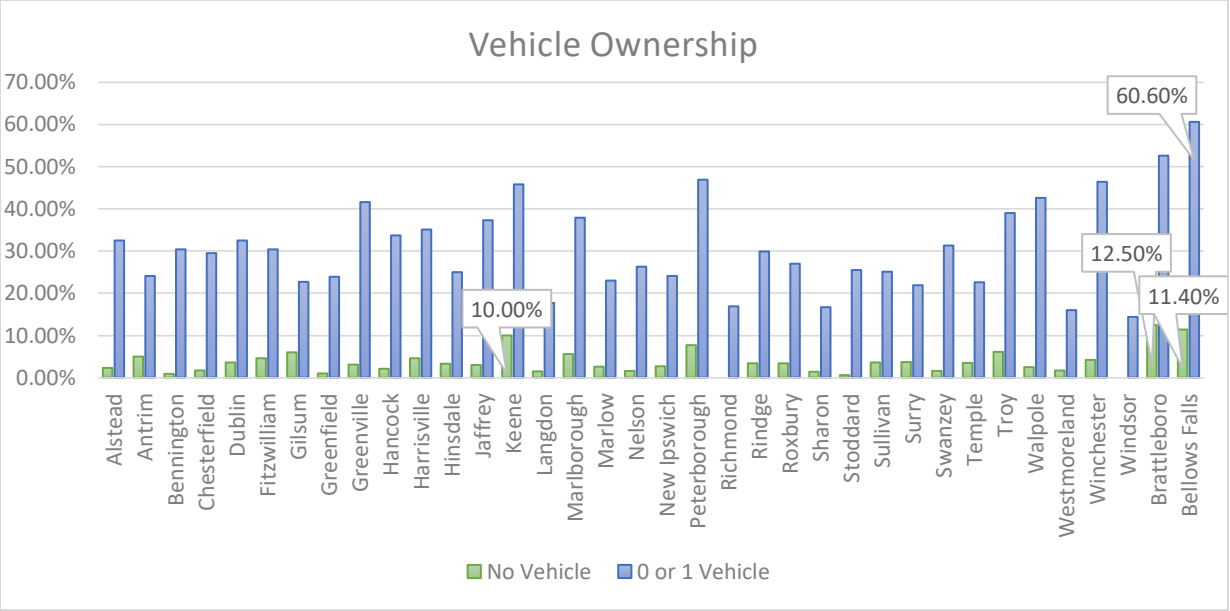


Figure 4.4: *Vehicle ownership in each area, two categories: No Vehicle, 0 or 1 Vehicles. Data source: US Census Bureau. Created by: Lisa Donnelly.*

The next criterion is based on research that residents in car-sharing neighborhoods are more likely to walk to work or take the transit, rather than drive (compared to the rest of the region). Keene, Rindge, and Brattleboro, all meet the minimum service level requirement of 5% of the people walk to work (Figure 4.5).

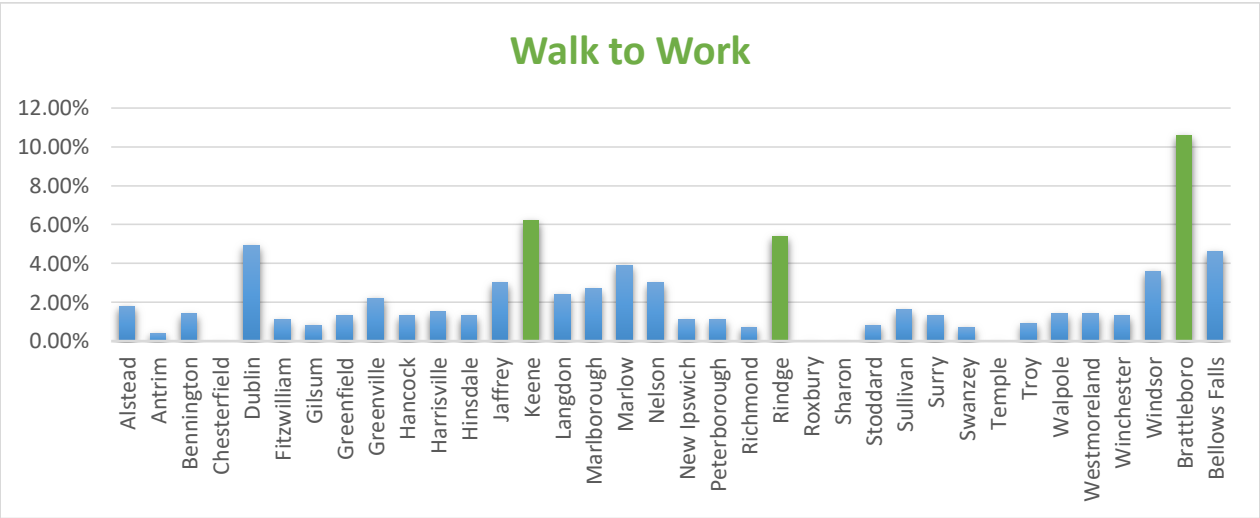


Figure 4.5: *Percent of people in each area that walk to work. Data source: US Census Bureau. Created by: Lisa Donnelly.*

The City of Keene met the three service level requirements, one-person households, vehicle ownership, and percent of people who walk to work. This is a good indication that the city has potential for a carsharing service to begin here. Including other considerations, like support from partner organizations the thresholds help determine the likelihood of success a carsharing program would have.

Ridesharing

On Route 9 in Chesterfield, New Hampshire is a small parking lot that leads to the trailhead for Chesterfield Gorge (Figure 4.6). The short hike is a popular spot for families and dog-walkers, but the trail is not the only reason someone might choose to park their car there. The parking lot also serves as the only official Park and Ride location in the Southwest Region. A second Park and Ride location can be found just outside the region in Hillsboro, New Hampshire.

Figure 4.6: *New Hampshire Park and Ride lot in Chesterfield. Photo Source: Lisa Donnelly.*

In spite of the lack of official facilities, ridesharing in the Southwest Region is relatively commonplace. According to the United States Census Bureau, just over eight percent of commutes to work in Cheshire County are via carpool; this is just under the national average of 9.8 percent (United States Census Bureau 2015). In the Southwest Region, rideshare rate data collection is being conducted by the SWRPC. A table of the number of carpools, vanpools, and fampools counted at peak hours in the morning and afternoon at select locations throughout the region can be found in Appendix B. This data collection allows the SWRPC to monitor traffic and understand the use of different transportation corridors, while offering insight into where future Park and Ride facilities and multimodal centers might be located. The data are also shared with MAST to provide a performance measure for the 2012 – 2020 Action Plan, which includes increasing the use of carpooling as an objective strategy.

Data collected between 2013 and 2016 show that the percentage of rideshare vehicles varies dramatically depending on the location and time of day (Appendices C and D). Further analysis of the data is needed, but peaks in rideshare counts may be influenced by fampools dropping off or picking up children from school, as well as commute related rush hours (Figure 4.7). In addition to Park and Ride facilities and the casual organization of family and work-related rideshares, the most frequently used method of organizing a rideshare program utilizes an online message board to group drivers and passengers together. In 2008, the Community Volunteer Transportation Company (CVTC) organized a rideshare program in southwest New Hampshire that included a free online rideshare board. Members without access to the internet were able to post ride requests or look for ride offers using a toll-free number. The ride board was eventually shut down when the New Hampshire Department of Transportation (NH DOT)

launched the NH Rideshare website, which offers information on using Park and Ride facilities, as well as a statewide ride match service. The CVTC continues to offer free rides to people who have limited mobility due to age, ability, and economic situation.

Figure 4.7: *Fampool school drop off. Photo source: Lisa Donnelly.*

Online rideshare websites have also been promoted on the Keene State College campus in the past. In 2008, the college promoted carpooling through erideshare.com and offered prizes to faculty, staff, and students for participating (Keene State College 2008). According to the Keene State College facebook page, the college joined thecollegecarpool.com in 2012. Because the faculty members involved in these efforts are no longer with the College, we were unable to learn anything about the success or failure of these programs. However, neither of these programs are currently ongoing, which suggests that participation was not significant. The authors of this report attempted to reach out to the Keene State College Office of Sustainability, but have not yet received a response as of the date of publication.

City Express

As the only current form of public transportation in the City of Keene, the City Express caters to a variety of citizens, including major shopping areas, the downtown area, medical facilities, and recreational areas. The City Express is managed by Home, Healthcare, Hospice and Community Services (HSC), and maintains three bus routes with different locations served through the Transportation Center in Keene (Figure 4.8). The transportation system has been serving the Keene Community since 1974 and is currently managed by Michael Acerno, the Transportation Manager at HSC.

The Local Shuttle, or Bus 5, is a bus route that runs in a continuous circuit starting from the Transportation Center to downtown areas. This bus route caters to the younger generation by going to recreation and shopping areas and allowing to flag specific locations along the route (HSC 2014). The second shuttle route is Bus 1 which caters to the older generation. Bus 1 runs through the downtown and reaches places such as the Hospital, Recreation Center, and Library. The last operating bus route is the Campus, a shuttle that runs in a continuous loop along the Keene State College campus (Figure 4.9). The shuttle serves as a free an easy transportation option for students without a car, especially those coming to the college from out of state. The campus shuttle runs to major shopping areas like the Monadnock Market Place, Riverside Plaza, as well as reaching Market Basket in Swanzey New Hampshire.

Other routes are provided by the HSC via the Friendly Bus. The Friendly Bus provides transportation assistance to senior citizens age 60 and over. This route is available to senior citizens that are unable to easily travel to appointments (HSC 2014). Other services include two routes needed when requested, Medical Transportation and the Para Express.

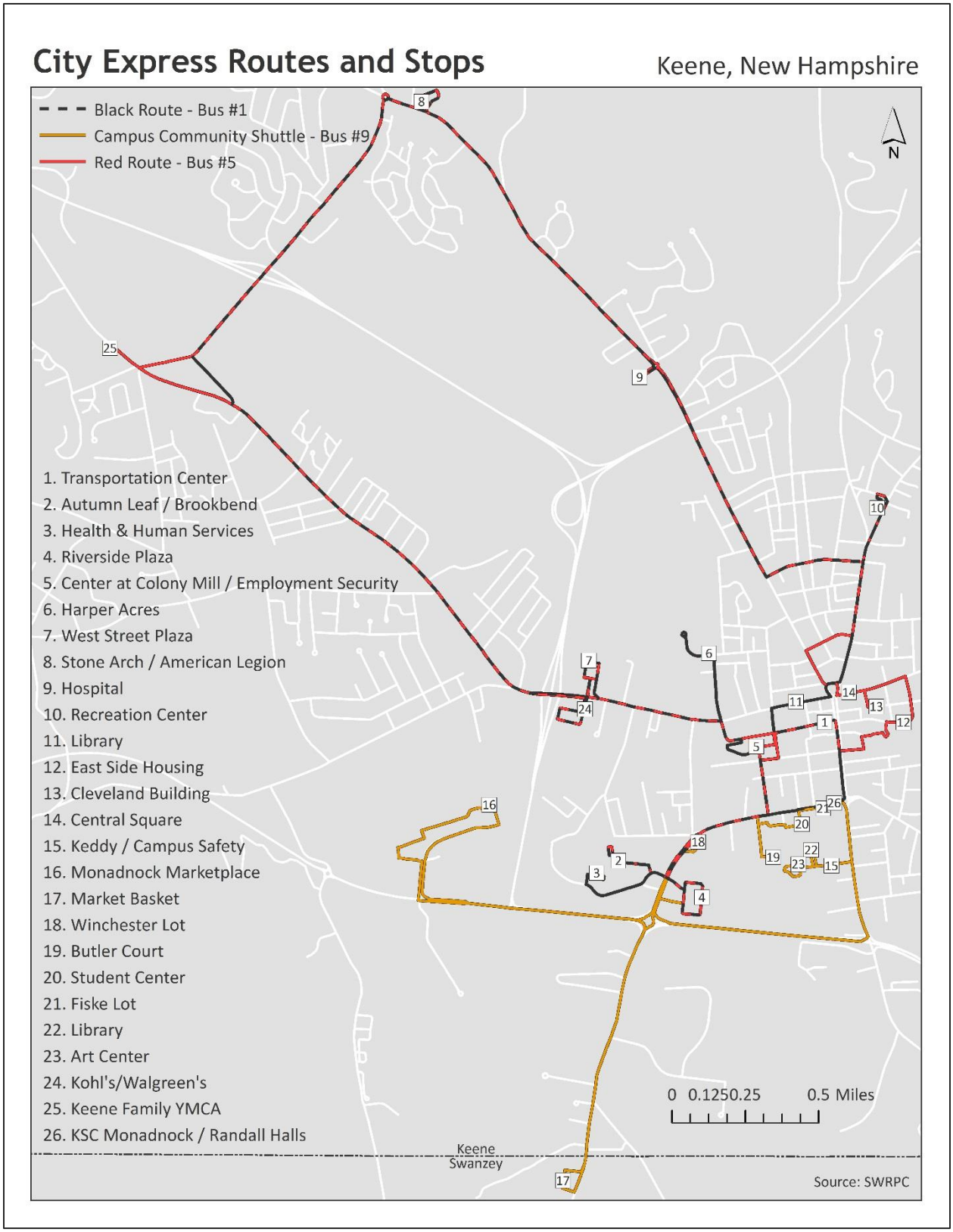


Figure 4.8: *City Express Routes and Stops. Created by Lisa Donnelly.*

The Medical Transportation Bus allows for inexpensive transportation to areas such as Lebanon NH and White River Junction in Vermont for those who need to reach medical assistance areas. The Para Express is available to citizens of any age and allows for transportation to those with a disability (HSC 2014).

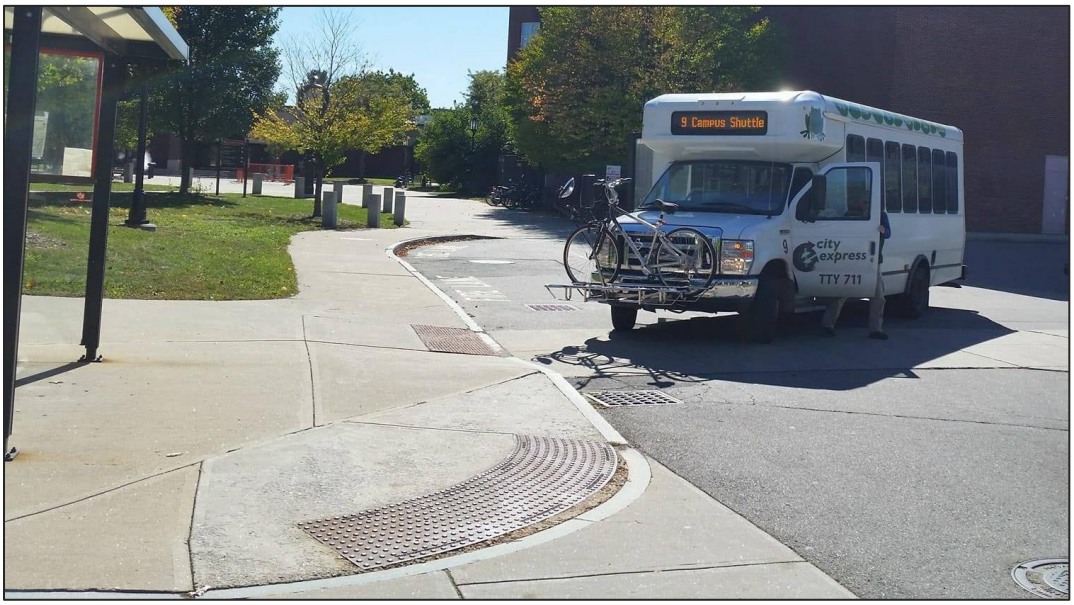


Figure 4.9: *The City Express Campus Shuttle stopping for students on the Keene State College campus. Photo Source: Lisa Donnelly.*

Over the last few years, the City Express has maintained steady ridership. In past ridership tracking, all bus routes for the City Express generally has an estimated 45 to 50 thousand rides a year (Acerno 2017, Personal Communication). Bus 1 (Black route) transports the most riders in one year based on the data collected in the 2016-2017 fiscal year (Figure 4.10). This is due to the popularity of older citizens taking this route to access areas most popular to the older generation such as the Hospital, Recreation Center, and library employment/health and human services. Bus 5 (Red Route) transports the second most riders within a fiscal year. An increase in riders getting on in earlier stops and getting off at shopping areas indicates shopping areas as a popular bus stop (Figure 4.11).

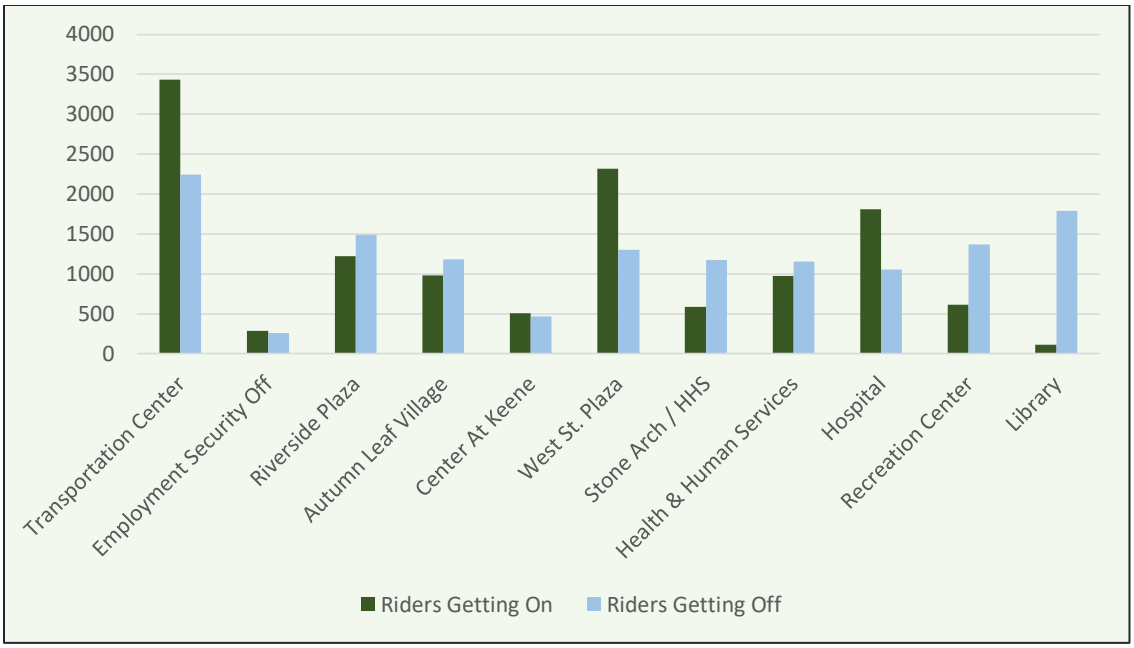


Figure 4.10: *Number of riders getting on and off the Bus 1 route based on bus stop during the 2016-2017 fiscal year. Data source: HCS. Created by Gabriela Pacheco.*

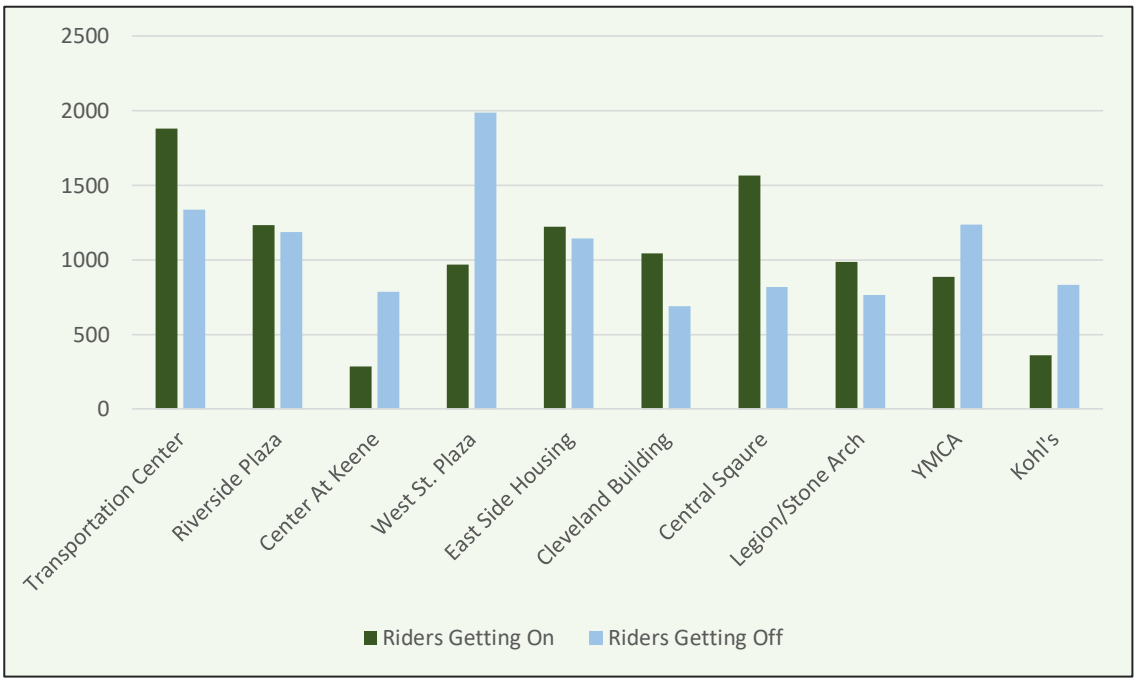


Figure 4.11: *Number of riders getting on and off the Bus 5 route based on bus stops during the 2016-2017 fiscal year. Data source: HCS. Created by Gabriela Pacheco.*

Lately, the HSC has noticed a significantly smaller number of college student ridership compared to bus routes that serve the entire Keene community. The campus shuttle reaches areas of Keene focusing on grocery and clothes shopping, however, mostly highlights areas across the Keene State College campus. Since KSC does not allow students to park their cars close to dorm rooms on campus, students are more likely to take the bus from areas like far parking lots to travel to their cars or to their dorms. However, for the students that do not have the luxury of having a car while at college, the City Express is an important transportation service for areas such as the Monadnock Market Place. This can be seen in the ridership totals of the Monadnock Market Place during the 2016-2017 fiscal year (Table 4.5). Locations like the Hospital and Recreation Center are not included in the KSC Shuttle in an attempt to transport students to popular destinations for young adults in Keene as quickly as possible.

Table 4.5: *Number of riders getting on and off the KSC Shuttle at specific locations. Data source: HCS. Created by Aimee Pacheco.*

Location	**Riders Getting On**	**Riders Getting Off**
Visitors lot	191	9
Riverside Plaza	498	389
Monadnock Market Place	981	824
Market Basket	169	213
Winchester Lot	144	133
Butler Court	336	281
Student Center	291	235
Fiske Lot	115	520
Library / Dining Commons	61	115
Art Center	207	147

The Campus Shuttle is the longest running route, transporting students between 7AM to 7PM, Mondays through Fridays. The specific locations during the KSC shuttle route allows for the shuttle to travel a full circuit in an efficient time for students. Vast numbers of students tend to

get on and off the bus between the times of 8:30 – 9:30, 1:00 – 2:00, and 3:00 – 4:00 (Figure 4.12).

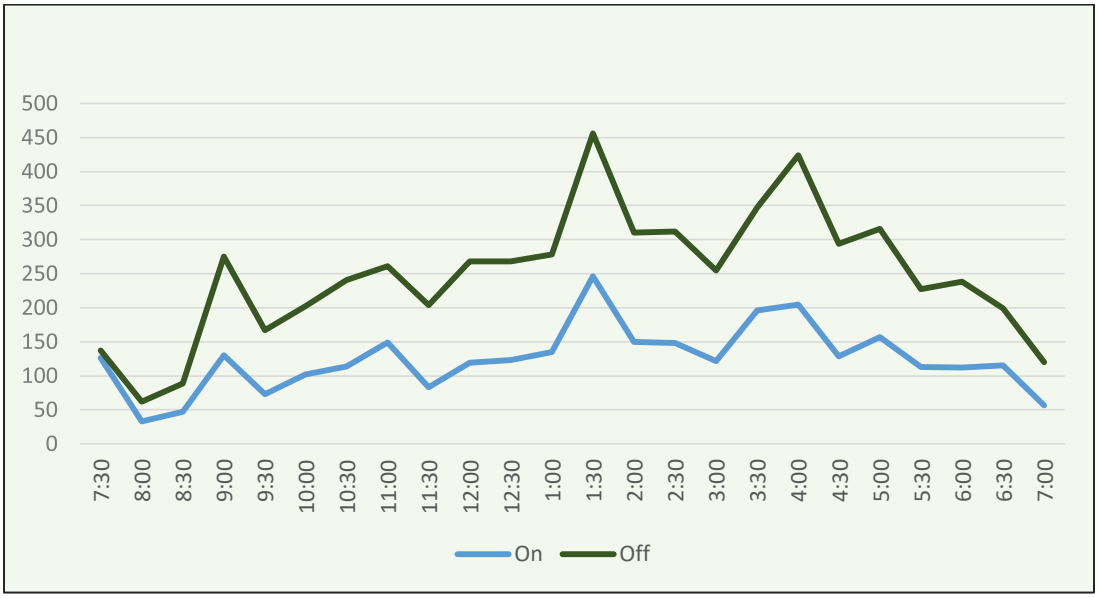


Figure 4.12: *Number of riders getting on and off the KSC shuttle at each half hour for the 2016-2017 fiscal year. Date Source: HCS. Created by: Gabriela Pacheco.*

Recently, the HCS has not been able to encourage college riders to frequently use the bus as much as desired. Although the shuttle caters to typical locations to which students would travel, a lack of knowledge in preferred locations for today's generation of students does not exist. There also is a potential issue with current methods for advertisement. The main poster for the City Express contains the slogan, "It's hip to hop the bus" (Figure 4.13). The current poster seems to be aimed toward the elderly and very young population in Keene, however, college students do not seem to be encouraged to ride public transportation. Other forms of advertisement include, radio advertisements, pamphlets, in-person conversations, and ads in the local newspaper. All forms of advertisement cater to the greater Keene community, but do not reach out to current college students, especially in today's technological age. Suggested methods

in which to advertise include a focus on being environmentally conscious. This includes in emphasis on the sustainability aspect of public transportation such as greenhouse gas emissions and the sense of community.

Figure 4.13: *The current KSC Shuttle advertisement. Source: Home, Healthcare, Hospice and Community Care 2014.*

Overall, the City Express has provided many Keene residents with the ability to travel to popular locations across Keene at a reasonable price. As the only form of public transportation in the city, the City Express is working to build its ridership, especially for the Keene State College Campus Shuttle. Areas in which they can increase ridership is through advertisement; encouraging a focus on living a more sustainable lifestyle will interest students while also reaching out to incoming students. Also, a change or addition in bus locations will allows other residents to use public transportation as the City Express reaches areas of high popularity.

Chapter 5

Methodology and Results

The data collection for this project included two separate surveys. Both surveys asked basic demographic questions, but did not collect any identifying information. The first survey was created for MAST and offered online and promoted through the City of Keene website, the MAST website, and various social media platforms. The online survey targeted permanent residents across the Monadnock Region and asked participants specific questions about carsharing. A second paper survey, generated by the authors, was tailored to the student population at Keene State College (Appendix F). The student surveys were distributed to random classrooms on campus, and asked questions about carsharing, ridesharing, and public transportation.

Demographics

The ages of the Keene State College students that took our survey ranged from 17 to 25 years old (Figure 5.1). The majority of students that took it were 21 years old, about 38.4 percent of the survey participants. Compared to the Southwest Region resident carshare survey, the ages range from under 21 years old to over 65 years old. However, only 1.2 percent of the resident survey are under 21 years old, while, 50 percent of the survey participants are between 50 and 64 years of age (Figure 5.2). The age disparity between respondents of the two surveys affords an opportunity for important comparative analysis between college students and the generally older, more permanent population of Keene and the Monadnock Region.

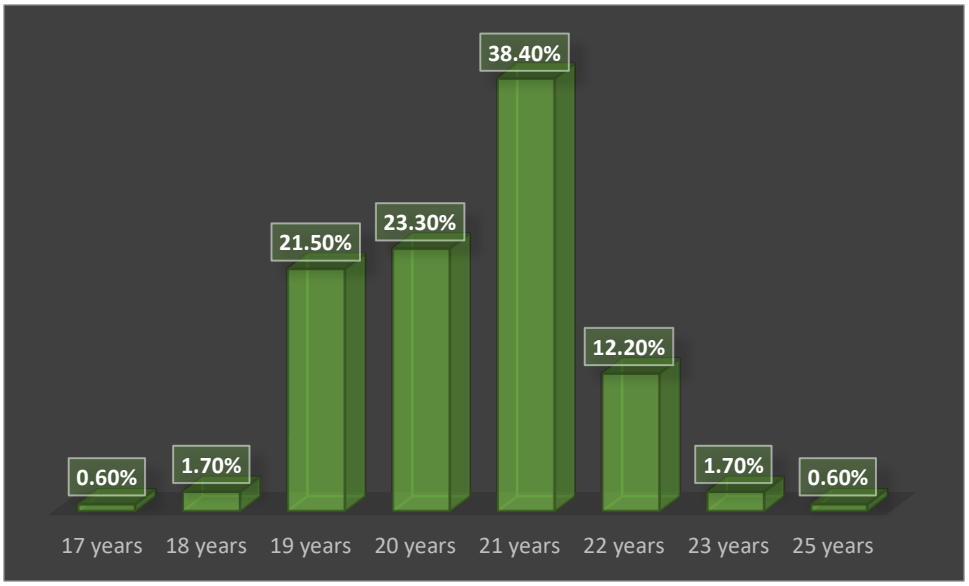


Figure 5.1: *Age percentages of student survey responders. Created by Aimee Krafft.*

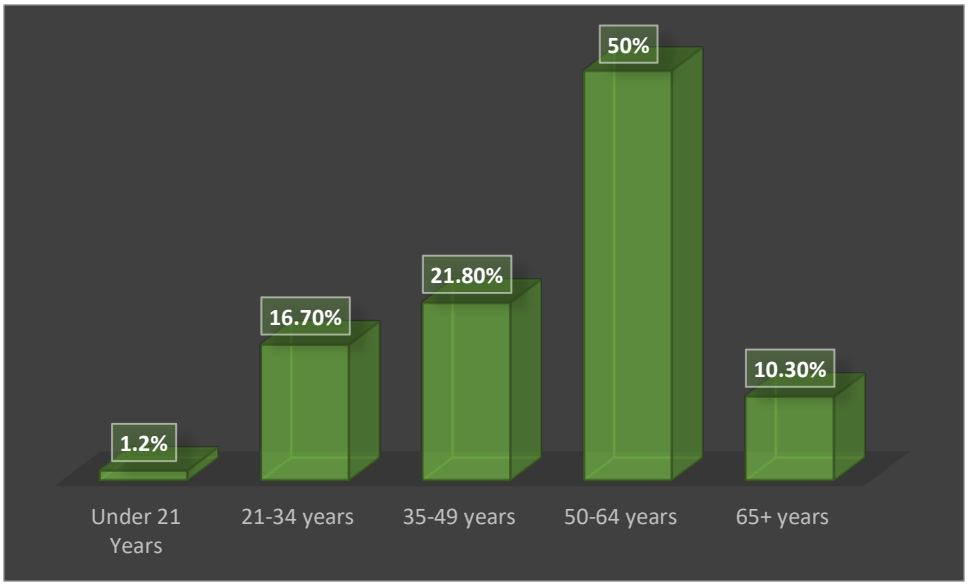


Figure 5.2: *Age percentages of Southwest Region resident survey responders. Created by Aimee Krafft.*

Out of a total of 172 survey responses from Keene State College students, 145 identified the benefit of sustainable transportation that is most important to them (Figure 5.3). Of the students that answered, 62 percent (90 respondents), are most interested in saving money on transportation costs. Compared to the regional carshare survey, saving money on transportation

costs was also the most consequential perceived benefit of sustainable transportation. Clearly, economics is the motivating factor behind interest in carshare.

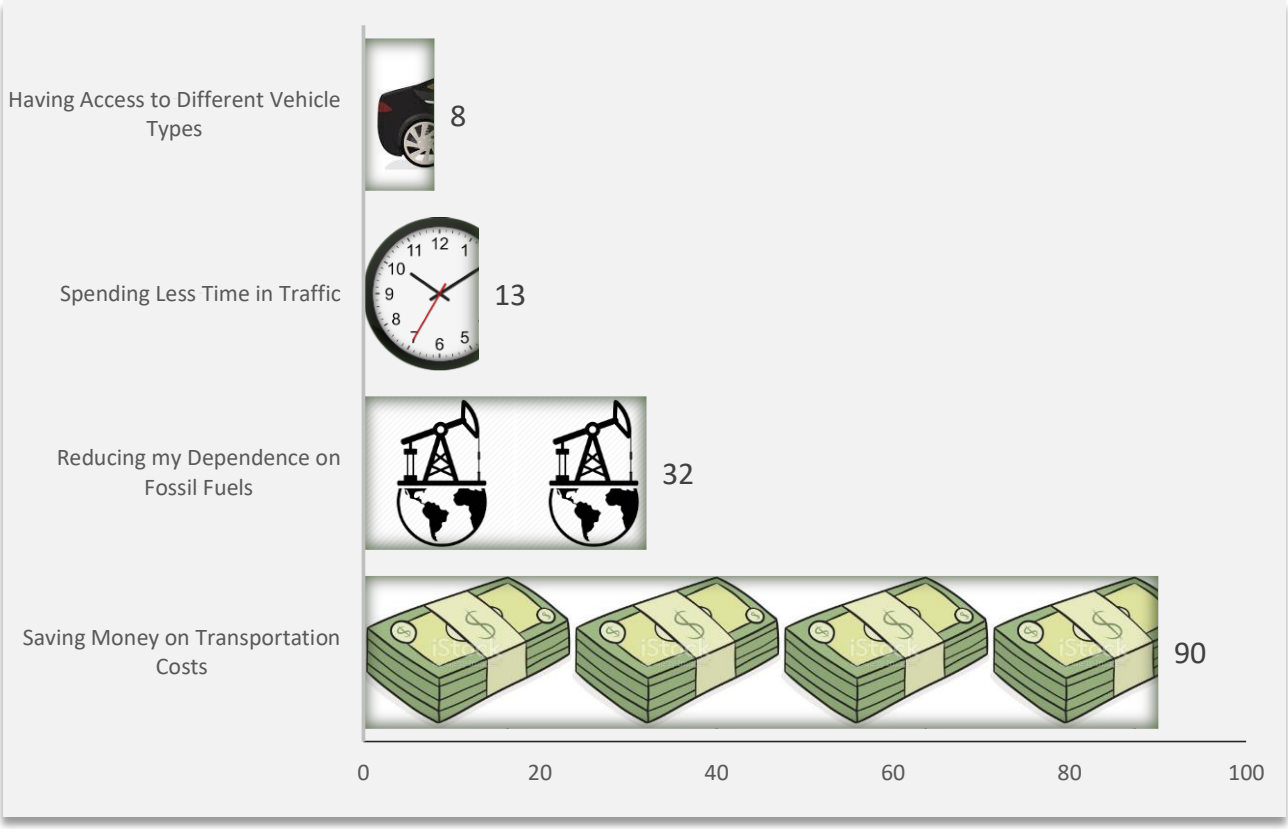


Figure 5.3: *Student interest level on benefits of sustainable transportation. Created by Gabriela Pacheco.*

In the survey, we asked how often students have used specific modes of transportation in the last month. The modes of transportation included walking, biking, using the bus, using a car, and carpooling (Figure 5.4). Walking was by far the most popular form of daily transportation while using the bus was the least used form of transportation in a month. Biking was also not very popular, with a majority of students reporting that they have not used a bike within the last month. Although many students own a personal car in Keene, most students also said they use their cars a few times per week. These results are telling, and indicate that neither the colleges green bikes program nor the City Express are utilized to any great extent.

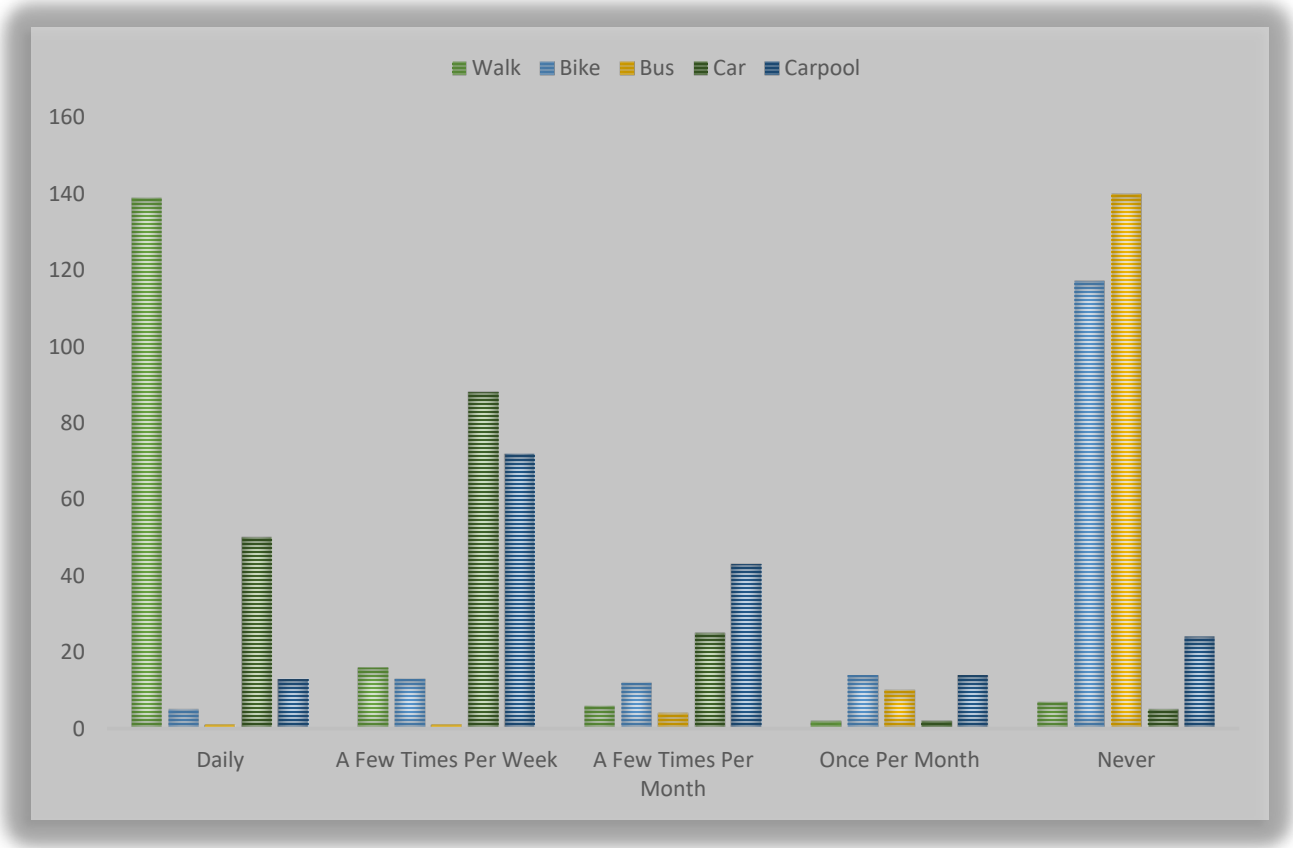


Figure 5.4: *Student transportation mode and frequency. Created by Gabriela Pacheco.*

Carsharing

At the outset of this study, it was hypothesized that a carshare is more likely to be successful in Keene than in other towns within the Monadnock region due to the presence of the student population in the city. To test the hypothesis, we surveyed Keene State College students to determine if a significant difference exists between people who own or do not own personal vehicles and the likelihood they would use a carshare service. The students were asked "Do you own a personal car for transportation in Keene?" and given a Yes or No option (Table 5.1). A follow up question asked, "If a carshare service was available in Keene, what is the likelihood that you would use it?", Response options of: very unlikely, unlikely, neutral, likely, and very likely,

were given associated Likert scale values of 1-5. Results reveal the likelihood of using a carshare service for those who own a personal car on campus is 2.55, and those who do not is 2.93. This means the average answer was for both categories is between "unlikely and neutral". Using SPSS, a two-sample independent T-Test was run to calculate the value of significance. This resulted in a significance of less than .05 at .029, therefore there is a significant difference between those who own their own cars and those who do not own private vehicles in terms of the likelihood of carshare usage. Due to the statistically significant difference, our result indicates that ownership of a personal car in Keene does impact the decision to use a carshare service, and that students with access to a personal vehicle are significantly less likely to use a carshare service than those without personal auto access (Table 5.2).

Table 5.1: *Private vehicle ownership and likelihood of joining a carshare service.*

	Q7	Number	Mean	Std. Deviation	Std. Error Mean
Q13	Yes	127	2.55	1.051	.094
	No	45	2.93	.953	.144

Table 5.2: *Two sample independent T-Test. Private vehicle ownership and likelihood of joining a carshare service.*

	Levenee's Test for Equality of Variance		T-Test for Equality of Means					95% Confidence Interval of Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q13 Equal Variances Assumed	4.972	.027	-2.133	168	.034	-.381	.179	-.734	-.028
Equal Variances Not Assumed			-2.223	84.310	.029	-.381	.172	-.723	-.40

To further test our overarching hypothesis, we surveyed students to determine if there is a significant difference between students that live on or off campus, and the level of support for a campus carshare parking space. The students were asked, "What type of housing do you live in?" and "What is your level of support for a dedicated carshare parking space on campus?". Options included: strongly oppose, oppose, neutral, support, strongly support. There is a total of 61 survey respondents living on campus and 108 students living off campus. The support level for students that live on campus had a mean of 3.59, as compared to 3.48 for those off campus (Table 5.3). The average answer for both categories is between "Neutral and Support". The significance is greater than .05 at .408, therefore there is no a significant difference between students that live on and off campus, and their level of support for a carshare parking spot on campus. This reveals that students residence location does not affect level of support for dedicated carshare parking space. Due to the existence of a significant difference, the null hypothesis is accepted (Table 5.4).

Table 5.3: *On or off campus housing and parking.*

	Q3	Number	Mean	Std. Deviation	Std. Error Mean
Q16	On Campus	61	3.59	.804	.103
	Off Campus	108	3.48	.826	.079

Table 5.4: *Two sample independent T-Test. On or off campus housing and parking.*

	Levenee's Test for Equality of Variance		T-Test for Equality of Means					95% Confidence Interval of Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q16 Equal Variances Assumed	.335	.563	.830	167	.408	.109	.131	-.150	-.367
Equal Variances Not Assumed			.836	127.473	.405	.109	.130	-.149	-.366

Another question asked on the survey is whether the student would be less likely to bring their own car to campus if a carshare service were available. Since there is no significant difference between people own personal vehicles and the likelihood of using a carshare service, students would be less likely to bring their own car to campus. In fact, 47.6 percent of students said they would not stop bringing their car to Keene even with the availability of a carshare service. A total of 23.8 percent of students believe the opposite while 28.6 percent were neutral on the subject. Both Keene State College students and residents in the southwest region gave their opinions on how long they would be willing to walk to pick up a carshare vehicle. There were 172 students that answered this survey question, five students skipped over the question. The majority of students, 45 percent said they would only be willing to walk 5 minutes to pick up a carshare vehicle (Figure 5.5). In comparison, the majority of residents, 46% of them said they would be willing to walk 15 minutes to pick up a carshare vehicle (Figure 5.6). Southwest Region residents are willing to walk longer to pick up a carshare vehicle than are Keene State College students.

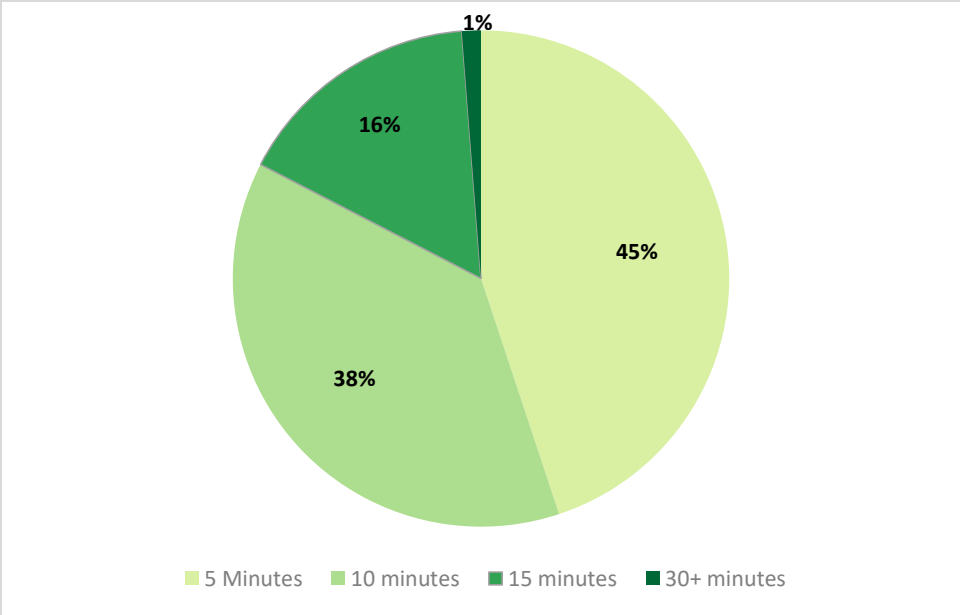


Figure 5.5: *How long students are willing to walk to pick up a carshare vehicle. Created by Aimee Krafft.*

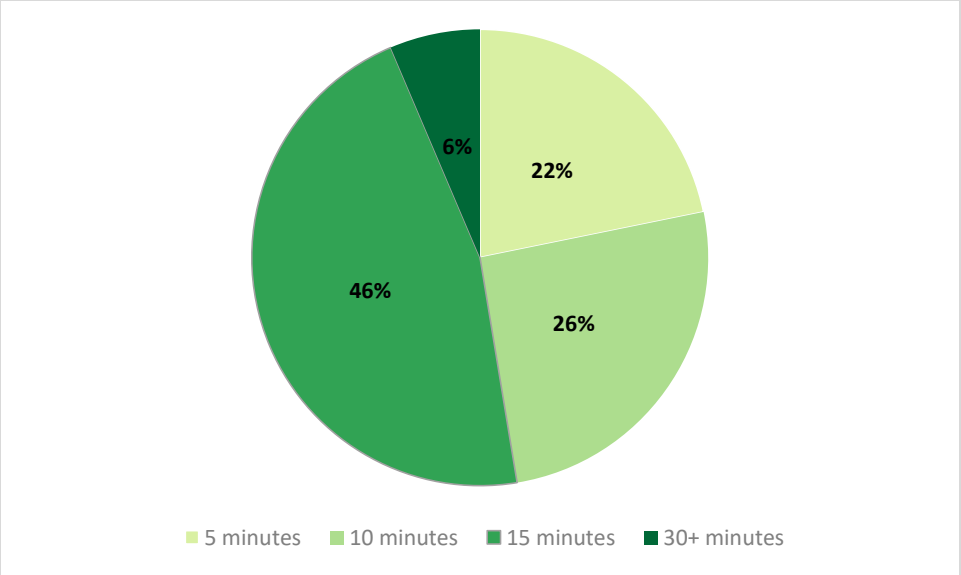


Figure 5.6: *How long southwest region residents are willing to walk to pick up a carshare vehicle. Created by Aimee Krafft.*

Ridesharing

Keene State college students were asked to choose their interest level in ridesharing, carpooling, and vanpooling from three categories; not interested, somewhat interested and very interested. A Chi Square test was run to determine the significance of the interest levels. The

majority of students, ninety-nine expressed that they were somewhat interested (Table 5.5). Combined with the fifty-two students that said they were very interested, the number of students who are interested is statistically significance with a value of about .000 (Table 5.6). Relating to our overarching hypothesis, the majority of students are interested in rideshare, and with an awareness of rideshare resources and an expansion of regional infrastructure there is a good chance that students will participate in a program.

Table 5.5: *Chi square interest level test.*

	Observed N	Expected N	Residual
Not interested	**20**	57.0	-37.0
Somewhat interested	**99**	57.0	42.0
Very interested	**52**	57.0	-5.0
Total	171		

Table 5.6: *Chi square interest level test.*

Chi-Square	55.404[a]
df	2
Asymp. Sig.	.000

Another aspect of rideshare in our survey focused on safety. We surveyed 116 females and 55 males on how important safety is as a factor for students when considering to rideshare. The students were given five options under "How important is safety in your decision whether or not to carpool?" The options were: not important, less important, neutral, important, and very important. A two-sample independent T-Test was run in SPSS between gender and safety. The significance value is about .000 which is lower than the level of significance, .05 (Table 5.7). This means that there is a statistical significance between females and males and how important safety is as a factor for ridesharing. Female students consider safety as more of an important factor than male students (Table 5.8). The mean of female answers was 4.34, roughly in between

"important and very important." The mean of male answers was 3.56, a little above "neutral" but not quite at "important." It is important to consider that female students take safety into consideration, as a high priority because a successful rideshare program should address the issue of safety and the precautions that are taken.

Table 5.7: *Two sample independent T-Test. Gender and safety when considering to rideshare.*

	Levenee's Test for Equality of Variance		**T-Test for Equality of Means**					95% Confidence Interval of Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q11 Equal Variances Assumed	12.041	.001	4.890	169	.000	.773	.158	.461	1.084
Equal Variances Not Assumed			4.278	78.367	.000	.773	.181	.413	1.132

Table 5.8*: Gender and safety group statistics.*

	Q2	**Number**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Q11	Female	116	4.34	.823	.076
	Male	55	3.56	1.214	.164

Most Keene State College students surveyed, 74 %, have used a carpooling app or website to find or offer a ride (Figure 5.7). This indicates that if regional rideshare infrastructure was updated, the liklihood that students would use the technology is high. If a lack of awareness is a factor for not using an app or online source, advertisements could help aid in the process of public awareness. The majority of the students have used a carpooling app or website before, so one can predict that they would be willing to again.

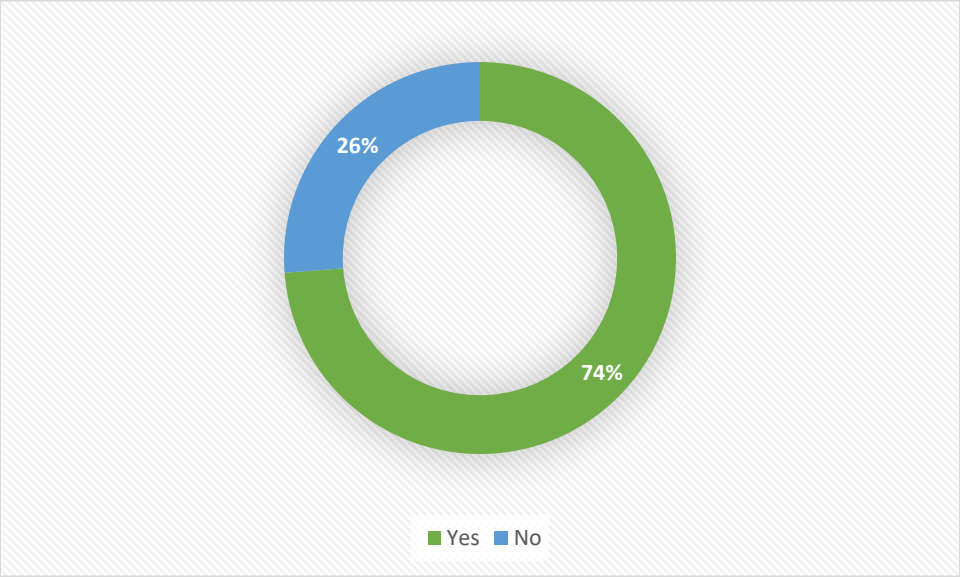


Figure 5.7: *Percent of students who have used a carpooling website or app to find or offer a ride. Created by: Aimee Krafft.*

City Express

Of the 172 surveys collected from students, 89 percent of the students reported that they never ride the bus (Figure 5.8). Sixteen students said that they have ridden the bus one to five times, one student rode the bus six to ten times, and two students have ridden the bus more than ten times this semester. Due to the insufficient sample size of student ridership, the third hypothesis could not be tested using SPSS analysis. However, the lack of student riders suggests that other kinds of analysis should be done to identify roadblocks to increasing student ridership. Several questions were asked in the student survey to help identify reasons why they choose not to ride the bus, what types of activities they would use the bus for, and how long they are willing to ride the bus in order to reach their destination.

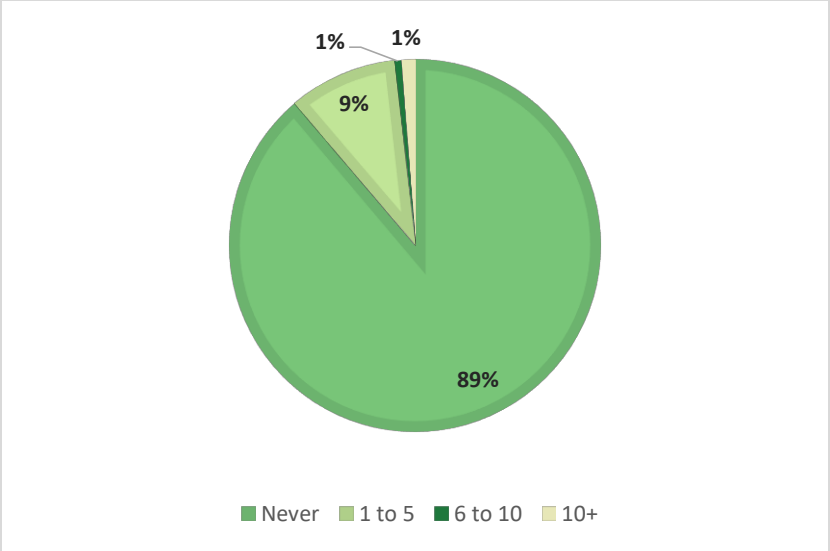


Figure 5.8*: Student City Express ridership in the past month. Created by Lisa Donnelly.*

Survey participants were asked to identify factors that stop them from riding the City Express by choosing two out of five factors from a list (Table 5.8). Most of the students said that they were either 'unaware of the bus schedule', or 'uninterested' in riding the bus. Time was the third most important factor. Many of the participants said that they wanted to get to 'off route destinations' that were not included in the bus route. Most of the participants that selected 'other' specified that they already own or have access to a personal vehicle.

Table 5.9: *Factors that prevent students from riding the KSC Shuttle.*

Uninterested	65
Time	43
Unaware of the bus schedule	75
Off route destinations	29
Other	24

In addition to asking students to identify reasons they do not ride the bus, the student survey gave participants an opportunity to write in the locations that they would like to be able access via the bus. Most of the responses can be organized into larger groups, which results in a short list of frequently requested locations (Figure 5.9). Some of these groups, as well as some of the individual destinations and existing bus stops, are already on the Campus Community Bus route. Examining the existing stops and desired destinations in a single map highlights where the Campus Community Shuttle is successful, as well as where improvements may be made (Figure 5.10).

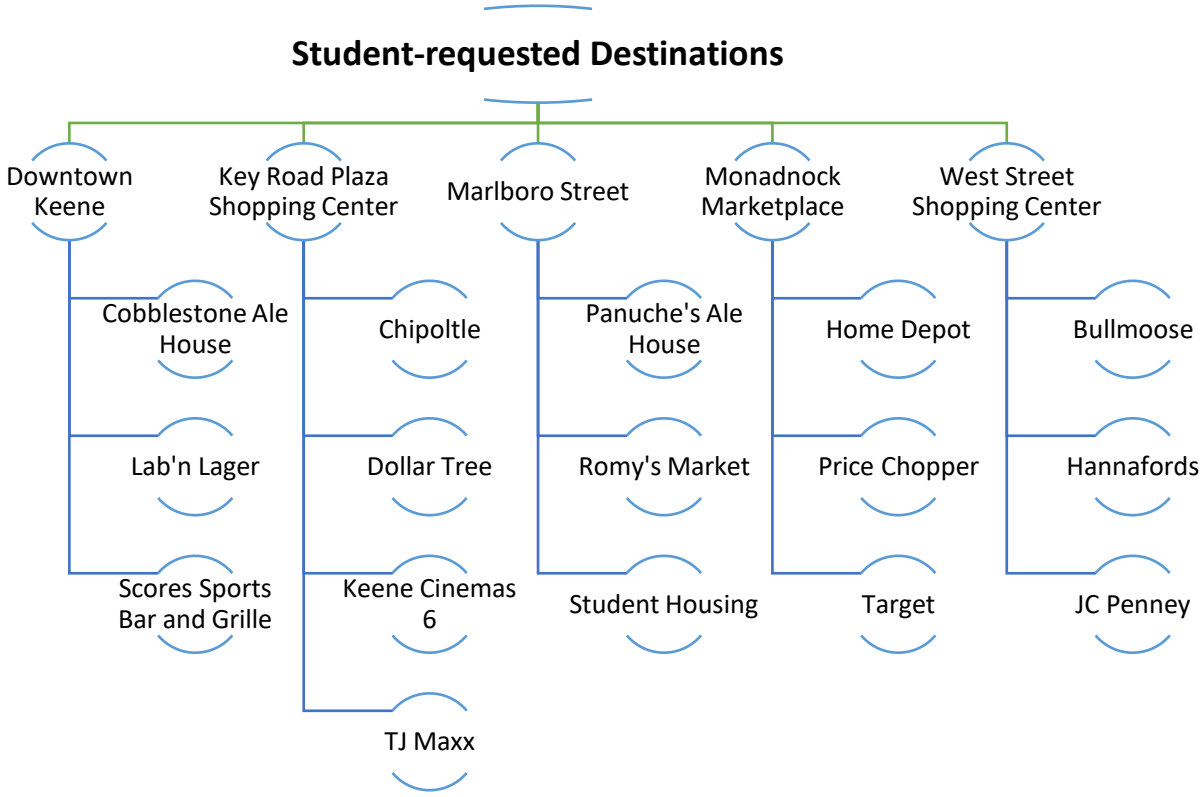


Figure 5.9: *Student-requested destinations by group. Created by Lisa Donnelly.*

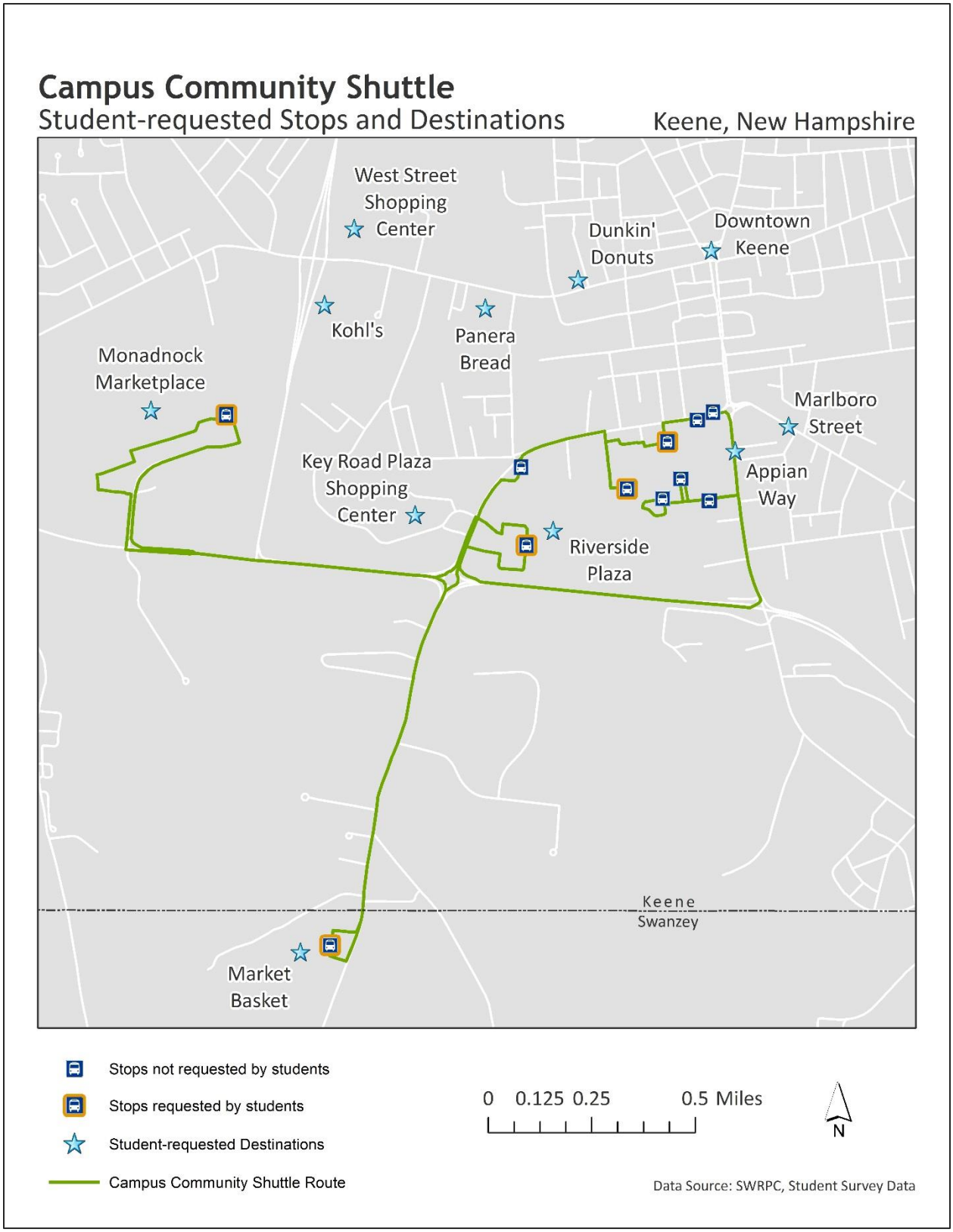


Figure 5.10: *City Express campus community shuttle student requested destinations. Created by Lisa Donnelly.*

While many of these destinations are accessible via the Black or Red routes, reaching these destinations also usually involves transfers and longer travel times. Keene State College students were surveyed on how far they would be willing to ride the City Express bus to get to their destination (Figure 5.11). The majority of students, 34 percent, said they would be willing to ride for about 5-10 minutes. An even larger majority of 50.6 percent said they would not be willing to transfer buses to get to their location.

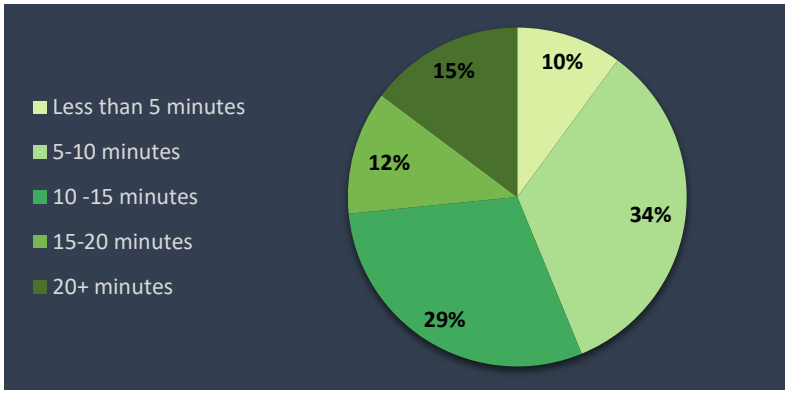


Figure 5.11: *How long students are willing to ride the bus to get to their destination. Created by Aimee Krafft.*

In an effort to further understand why so few students take advantage of the Campus Community Shuttle, a network analysis of off-campus housing in relation to stop locations was done using the Network Analysis tool in ArcGIS (Figure 5.12). Three service areas were created around distances of 0.5 miles, 1 mile, and 1.5 miles from the nearest bus stop. The results indicate that most of the off-campus housing is located within a half-mile of the nearest Campus Community Shuttle stop. This is consistent with the survey data, where 70 percent of off-campus students reported living less than a half-mile from campus (Figure 5.13). Most of the student housing that is located farther away from the KSC campus is also within a 0.5-mile distance from the nearest City Express bus stop, but the limited hours on the Red and Black routes make it an unlikely transportation choice for students since many are still in class after 4:00 P.M.

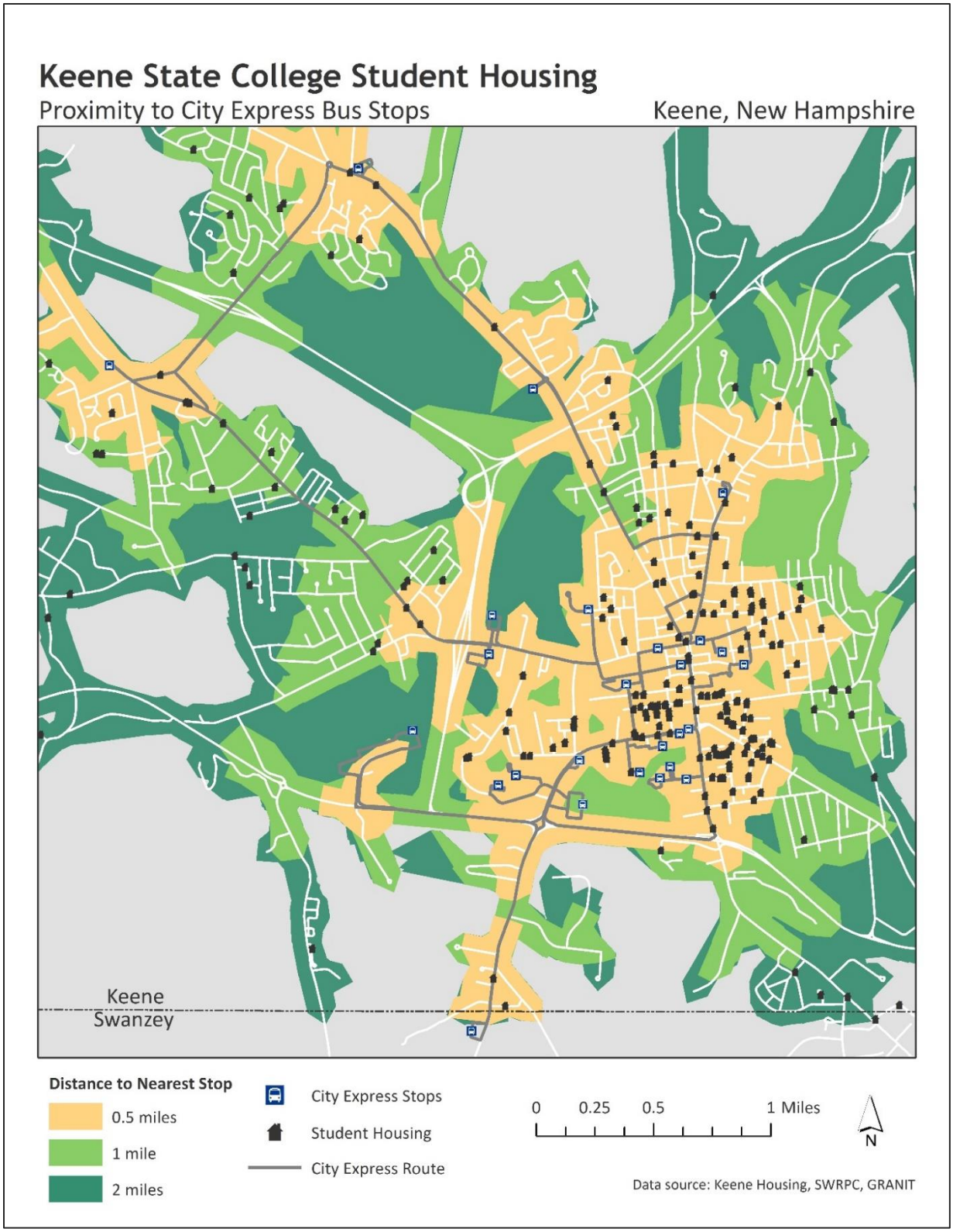


Figure 5.12: Keene State College student housing and City Express stop network Analysis. Created by Lisa Donnelly.

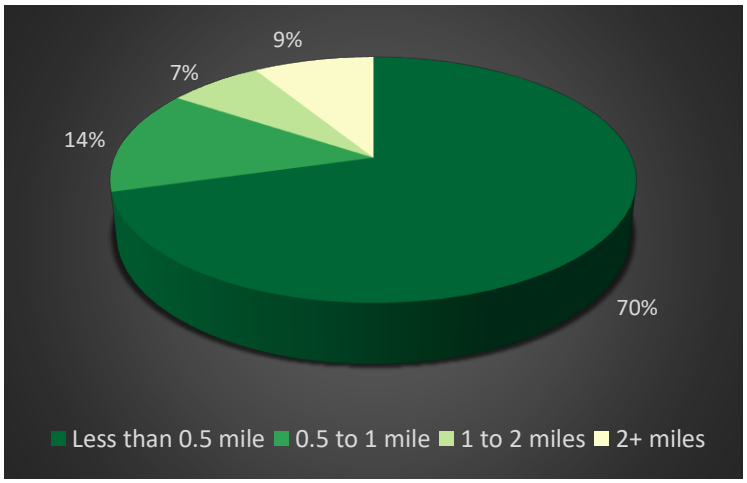


Figure 5.13: *Off-campus housing distance from campus. Created by Lisa Donnelly.*

The off-campus students were also asked to identify the form of transportation they most often use to travel to the KSC campus. As expected, because most off-campus student housing is less than 0.5 miles from the college, most students walk to campus. Compared to the 65 students that said they walk to the college, 35 students said they drive to campus, 3 said they ride a bike, one student said they ride the bus, and one said they ride a longboard to campus. While the number of students that use active transportation is encouraging, the number of students that use a private vehicle to travel such a short distance demonstrates how important it is to promote sustainable transportation options, including public transportation.

Chapter 6

Conclusions and Recommendations

Carshare

Before starting this study, we hypothesized a carshare operation is more likely to be successful in Keene than in other towns within the Monadnock Region due to the presence of the student population in the city. After completing our study, we believe there needs to be more research before a conclusion regarding our hypothesis can be reached. Our survey of students from Keene State College indicates support for a dedicated parking space on campus. It also reveals that student residence location does not deter support level for a dedicated carshare parking space. We also determined the likelihood to use a carshare service between those who own and do not own a personal vehicle. Although a carshare parking space is relatively supported, student also felt they are neutral or unlikely to use a carshare program if brought to Keene. Students with access to a personal vehicle are significantly less likely to use a carshare service than students without personal vehicles. Residents of the Monadnock Region seem to support the existence of an established carshare program as residents are more willing to walk longer distances to pick up a vehicle than are Keene State students.

A plausible reason for the lack of support for a carshare program could be due to the lack of knowledge when it comes to understanding how to use carshare and the overall benefits of the program. The Zipcar college program is one of the only carshare programs in the area that caters to the age range of college students. However, carshare programs do not usually allow riders under twenty-one to use their vehicles. In the future, a new carshare program in the City of Keene must be catered to the students lack of knowledge. Since more college students are under twenty-one and have no experience using carshare, there must be a large amount of educational outreach and advertising. Limitations in our study such as lack of time, and a focus

on just one form of sustainable transportation prevented us from such educational outreach and an explanation of the term, “carsharing” for survey participants.

Rideshare

We hypothesized that due to a lack of awareness of online resources and limited regional infrastructure, most rideshares in the Monadnock Region are informal fampools and carpools. Results from our study indicate that there is a statistical significance in the interest level of carpooling that can support the prediction that formal ridesharing would increase if more students were aware of rideshare resources, as well as additional regional infrastructure.

Along with a significant student interest, the majority of students have used a carpooling website or app (Figure 6). This indicates that students do take advantage of formal rideshare opportunities, and it should be noted that a large number of students wrote “Uber” as a carpooling app/website they have used. Our paper focused on non-profit forms of rideshare, but nevertheless student knowledge of using rideshare resources was still provided and serves a valuable indicator of formal rideshare uses.

A recommendation from survey data focusing on rideshare safety is the importance of developing and creating infrastructure that provides students with the comfort of safety. Female students especially said safety is an important decision on whether or not to carpool. A successful rideshare program should address the issue of safety and the precautions that have to be taken. New Hampshire’s official rideshare website would benefit from advertising safe practices and rideshare partnerships.

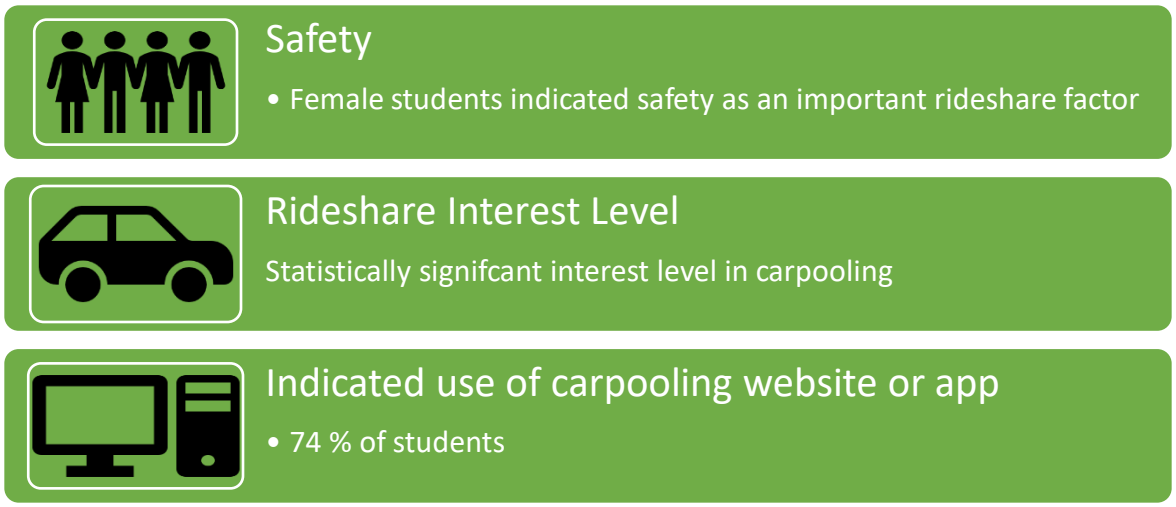


Figure 6.1: *Valuable information from Keene State College student surveys. Created by: Aimee Krafft.*

City Express

Our third hypothesis claims that student ridership on the City Express Campus Shuttle is low because the schedule and stop locations do not meet the transportation needs of the students. While we were unable to conduct statistical analysis using SPSS due to the low sample size of actual bus riders, we believe that the other kinds of analysis done with the data collected are sufficient to validate this hypothesis. The most significant findings can be divided into two categories; working strategies and areas of improvement.

There are several things that the City Express Campus Shuttle does well. Many of the stops on campus are easy to access and convenient, and the three main stops off campus are destinations that the students desire. It is also an inexpensive, environmentally friendly, and safe transportation option, which makes it an attractive choice for most millennials. It also runs later than the Red and Black City Express lines, which gives students time to use the shuttle even with a full course schedule.

The route map and the collected student data both provide insight as to why the Campus Community Shuttle ridership is so low. A quick glance at the route map suggests that the focus of the shuttle is primarily to move students from one campus location to another, with side trips to major shopping areas included. Because of the small size of the Keene State College campus, most students would likely rather take a five-minute walk down Appian Way than wait at a stop for a shuttle to take them on a much longer trip to cover the same distance. The fact that most off-campus housing is within a half-mile walk from the campus is also an issue, because there is no reason to ride the bus when students need to walk to the edge of campus to reach a stop anyway. Students that use the shuttle to get to off-campus locations like Market Basket or Target end up taking a much longer trip than desired because of the large number of stops that the bus has to make on campus, so many students choose to drive private vehicles or carpool to those locations. Most of the students surveyed expressed the opinion that they would like the bus to go to more locations off-campus. While many of these areas are accessible by transfer to another City Express route, students are more likely to visit these places in the late afternoon into the early evening, after the other buses have stopped running for the day.

With these challenges in mind, our first recommendation is to reduce the number of stops on the Keene State College campus. The relatively small size of the campus could easily be sufficiently serviced by three or four stops, which would cut down on travel time while making it possible to extend service to additional off-campus locations. The off-campus locations we recommend are:

- Marlboro Street – A significant number of survey participants requested stops at businesses on Marlboro Street, and the location is also convenient to a high-density cluster of student housing.

- Downtown Keene – Most students suggested Main Street or Downtown Keene as a potential location, and many also specifically mentioned restaurants and other businesses in that area that they would like access to.
- West Street Shopping Center – Several students wrote in businesses at this shopping center, specifically Hannafords, JC Penney, and Bullmoose. This stop would also open up access to other areas of West Street that the students mentioned, such as Kohl's, Panera Bread, and Dunkin' Donuts.
- Key Road Plaza Shopping Center – Many students requested businesses in this shopping center, including TJ Maxx, Dollar Tree, and Chipoltle. This stop could also act as an alternative to the Walmart stop.

We would also like to recommend the development of a marketing campaign that is directed specifically at college-age adults. While the current logo and slogan are cute and easy to remember, we feel that the theme is too juvenile to appeal to college age students in general.

During the length of time that this study was conducted, there were few limitations that we encountered, but they are significant enough to warrant further study. Although we were able to collect nearly 200 student surveys, our sample size of student ridership was well under the amount needed for statistical analysis. Because of this, we recommend further study that aims to fill that gap by collecting data from a sufficient number of student riders. Another limitation is our lack of expertise in public transportation policy. We believe that a better understanding of how to equitably meet the needs of the community according to what is required by law, would help us to formulate recommendations that are more likely to have an effective impact. As with the other transportation options investigated in this report, the City Express has both promise and pitfalls. The future of these options, however, is ultimately optimistic.

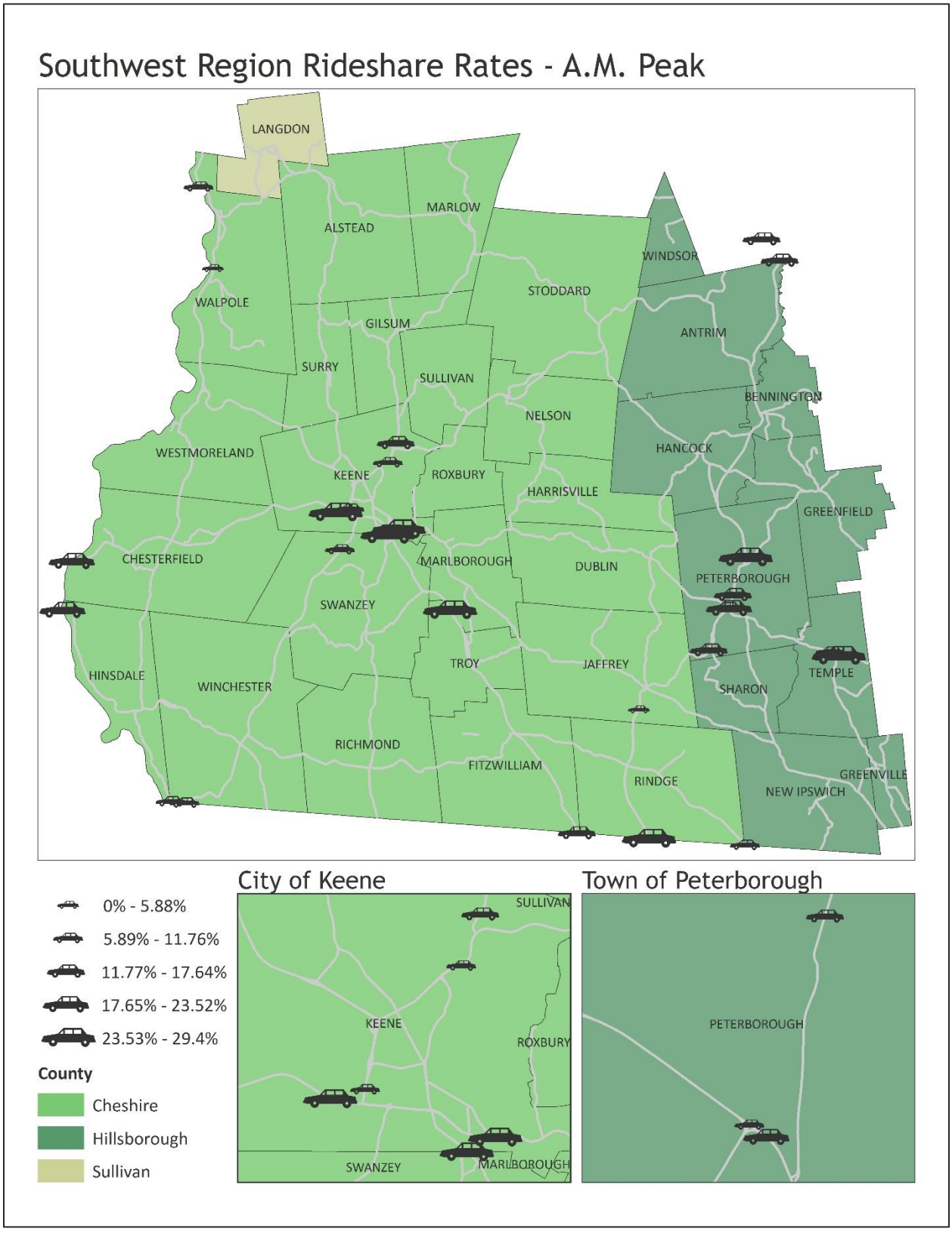
Appendix A: Literature summary table

	Demographics	Benefits	Challenges
Carsharing	• Growing industry • Different types of carshare models include for-profit and co-op • Most members are between age 25-45 • Person households, households with 0 or 1 vehicles, people who walk or take public transportation most likely to carshare	• Decrease in privately owned cars • Decrease in vehicle maintenance fees • Encourage physical activities such as biking and walking • Encouraging a decrease in greenhouse gas emission	• Vehicle Maintenance • Available Parking Spaces • Car Availability
Ridesharing	• Families and coworkers make up majority of carpools • Younger millennials and students carpool more often than employed adults over age 25 • Perceived social and environmental benefits also encourage ridesharing	• Decrease traffic congestion • Decrease in individual commuting • Save money by decreasing the amount of used gas • Encouraging a decrease in greenhouse gases and air pollution per person	• Transaction Costs • Advertising and Marketing Success • Preferred flexibility of personal schedules
Public Transportation	• Race and Ethnicity has a significant impact on public transit use • Most passengers are adults age 25-54 • Majority of trips are work-related • Vulnerable populations heavily dependent on public transportation	• Less/no car maintenance fees • Decrease paved parking lots and more greenspace • Minimize highway/road traffic congestion • Encouraging a community effort for lowering greenhouse gases, air, water, and resource consumption.	• Traffic Congestion • Transit system connectivity • Parking difficulties • Perception of public transportation as undesirable.

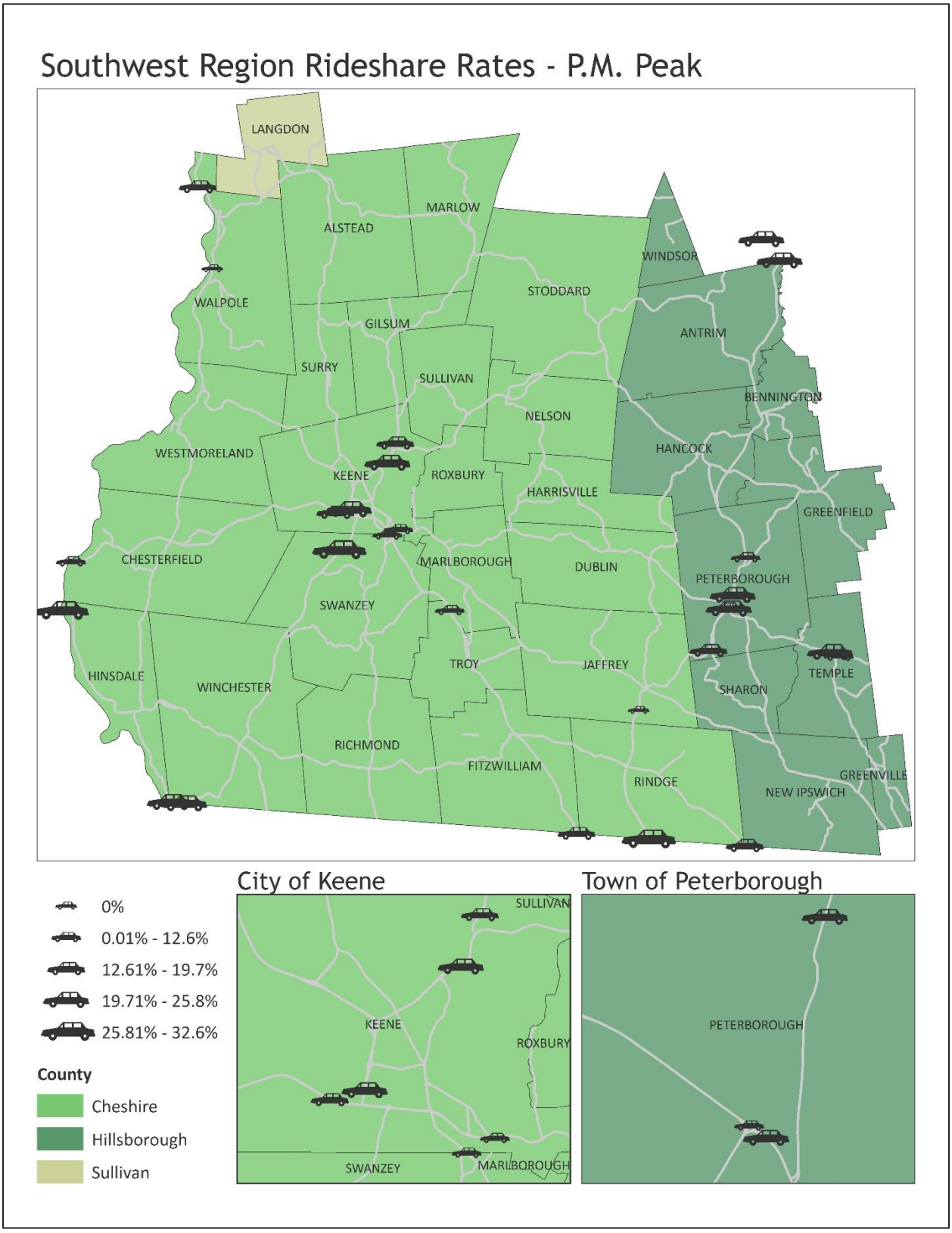
Appendix B: Carpool Count Locations and Peak Hour Percentages Table. Data source: SWRPC. Created by Lisa Donnelly.

Town	Location	Year	A.M. Peak (%)	P.M. Peak (%)
Chesterfield	NH 9 at Vermont state line	2013	12.3	21.6
		2016	23.1	8.8
Fitzwilliam	NH 12 at Massachusetts state line	2014	10.2	26.0
		2016	17.0	15.1
Hillsborough	NH 9 west of US 202	2014	15.5	25.8
Hillsborough	US 202 at Antrim town line	2014	15.5	25.8
Hinsdale	NH 119 at Vermont state line	2014	18.4	29.6
Keene	NH 9 east of Base Hill Road	2013	12.7	25.7
		2016	29.0	18.3
Keene	NH 9 east of Washington Street	2013	14.0	22.5
		2016	11.1	24.4
Keene	NH 101 east of Optical Avenue	2013	10.2	20.8
		2016	24.7	9.6
Keene	NH 9 10 and 12 south of West Street	2015	9.8	21.5
Keene	NH 10 north of NH 9	2015	13.3	18.5
Marlborough	NH 12 south of Webb Depot Road	2016	24.9	7.0
New Ipswich	NH 119 at Massachusetts state line	2015	9.1	15.3
Peterborough	NH 202 north of Main Street	2013	12.4	20.9
Peterborough	US 202 at intersection with NH 101	2015	5.6	15.8
		2015	8.9	12.6
Peterborough	US 202 south of NH 101	2015	17.2	15.6
Peterborough	NH 202 south of Pineridge Road	2016	24.6	9.5
Peterborough	NH 101 east of intersection with US 202	2015	19.2	24.7
Rindge	NH 202 at Massachusetts state line	2014	24.1	32.6
Swanzey	NH 10 south of Base Hill Road	2013	8.6	23.5
		2016	8.3	27.2
Swanzey	NH 12 at Keene Town Line	2013	8.5	20.7
		2016	23.9	10.7
Temple	NH 101 west of NH 45	2014	9.4	24.1
Temple	NH 101 east of NH 45	2016	29.4	11.6
Walpole	Arch Bridge Road at Vermont state line	2013	9.0	19.7
Winchester	NH 10 north of NH 63	2015	11.2	21.3
Winchester	NH 63 north of NH 10	2015	11.7	21.3

Appendix C: Carpool Count Locations A.M. Peak Map. Data source: SWRPC. Created by Lisa Donnelly.



Appendix D: Carpool Count Locations A.M. Peak Map. Data source: SWRPC. Created by Lisa Donnelly.



Appendix E: Student survey created by authors.

Keene, New Hampshire Transportation Survey

Geography Senior Seminar

Our research project focuses on alternative transportation such as, carshare, rideshare, and the City Express bus in Keene. We hope to gain an understanding of the interest level of students on these three forms of transportation.

1. What is your age? _____

2. What is your gender? _____

3. What type of housing do you live in?
☐ Dorm room ☐ Apartment ☐ House ☐ Other

4. What is your home state?

5. I am **most** interested in the following benefit of sustainable transportation (check one):
☐ Saving money on transportation costs
☐ Having access to different vehicle types
☐ Reducing my dependence on fossil fuels
☐ Other
☐ Spending less time in traffic by reducing the number of vehicles on the road

6. How often have you used the following modes of transportation **in the last month**?

	Daily	A few times per week	A few times Per month	Once per month	Never
Walk	☐	☐	☐	☐	☐
Bike	☐	☐	☐	☐	☐
Bus	☐	☐	☐	☐	☐
Car	☐	☐	☐	☐	☐
Carpool	☐	☐	☐	☐	☐
***Other**	☐	☐	☐	☐	☐

*If you checked other, please specify: _____

7. Do you own a personal car for transportation in Keene?
☐ Yes ☐ No

***Ridesharing** is the sharing of vehicles by passengers to reduce vehicle trips, traffic congestion and automobile emissions. Types of transportation that are considered ridesharing include carpool, vanpool.*

8. Please describe your interest level in ridesharing, including carpooling and vanpooling.
☐ Not interested ☐ Somewhat interested ☐ Very Interested

9. Have you ever used a carpooling website or app to find or offer a ride?
☐ Yes ☐ No

10. If yes, which one did you use? _____

11. How important is safety in your decision whether or not to carpool?
☐ Not Important ☐ Less Important ☐ Neutral ☐ Important ☐ Very Important

12. Have you ever used a carshare service?
☐ Yes ☐ No

13. If a carshare service was available in Keene, what is the likelihood that you would use it?
☐ Very unlikely ☐ Unlikely ☐ Neutral ☐ Likely ☐ Very likely

14. How far would you be willing to walk to pick up a carshare vehicle?
☐ 5 minutes ☐ 10 minutes ☐ 15 minutes ☐ 30+ minutes

15. If a carshare service were available, you would **be less likely** to bring your own car to campus.
☐ Strongly Disagree ☐Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

16. What is your level of support for a dedicated carshare parking space on campus?
☐ Strongly Oppose ☐ Oppose ☐ Neutral ☐ Support ☐ Strongly Support

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*The **City Express** is a bus system and the only form of public transportation in the City of Keene. This form of public transportation is free to KSC students and $1 for Keene residents.*

17. If you are familiar with the City Express, how did you hear about it?

18. How many times have you ridden the City Express this semester?
☐ 0 ☐ 1-5 ☐ 6-10 ☐ 10+

19. If you don't ride the bus, what top factors stop you from riding the City Express? (**Check two**):
☐ Uninterested ☐ Time ☐ Unaware of the bus schedule ☐ Off route destinations ☐ Other: _____

20. How long are you willing to ride the bus to get to your destination?
☐ Less than 5 minutes ☐ 5 - 10 minutes ☐ 10 - 15 minutes ☐ 15 - 20 minutes ☐ 20+ minutes

21. Please identify a specific location you would want the City Express to stop? _____

22. How important is safety in your decision to ride the City Express?
☐ Not Important ☐ Less Important ☐ Neutral ☐ Important ☐ Very Important

23. What might you use the City Express for? (Check all that apply):
☐ Shopping ☐ Work ☐ School ☐ Appointments ☐ Personal

24. Would you be willing to transfer to another bus to reach your destination?
☐ Yes ☐ No

For Off-Campus Students Only

25. How far do you live from campus?
☐ Less than a ½ mile ☐ ½ mile - 1 mile ☐ 1 - 2 miles ☐ 2+ miles

26. What is your **most common** form of transportation to campus?
☐ Car ☐ Walk ☐ Bus ☐ Bike ☐ Other: _____

27. How many times per week do you use this form of transportation? _____

Thank you for your participation! Your feedback is valued and very much appreciated!

References

Anderson, M. L. 2013. Subways, strikes, and slowdowns: the impacts of public transit on traffic congestion. https://ndc.gov.bd/lib_mgmt/webroot/earticle/473/Anderson_transit-Traffic_ Congestion.pdf (last accessed 9 October 2017).

Amey, A. 2011. "Real-Time" Ridesharing – The Opportunities and Challenges of Utilizing Mobile Phone Technology to Improve Rideshare Services. http://ridesharechoices.scripts.mit. edu/home/wpcontent/papers/AAmey_11.4161_TRB2011_RealTimeRides_Ver1.pdf (last accessed 9 October 2017).

Attoh, K. A. 2012. The Transportation Disadvantaged and the Right to the City in Syracuse, New York. The Geographical Bulletin. 53: 1-19.

Butler, B. 2013. Critical Issues in Transportation. Transportation Research Board of the National Academies. Washington, DC. http://onlinepubs.trb.org/Onlinepubs/general/criticalissues13.pdf (last accessed 8 October 2017).

Carshare Vermont 2016. How to become a member. http://www.carsharevt.org/how-it-works/ (last accessed 25 October 2017).

Celsor, C., and A. Millard-Ball. 2006. Where Does Car-Sharing Work? Using GIS to Assess Market Potential. Prepared for the 2007 Annual Meeting of the Transportation Research Board. Washington, D.C.

Chan, N. D., and S. A. Shaheen. 2011. Ridesharing in North America: Past, Present, and Future. *Transport Reviews*. 32 (1): 93-112.

Cheshire Medical Center/Dartmouth-Hitchcock. 2017. Annual Report 2016- 2017. Keene, NH: Simply Better Records.

City of Keene. 2007. Keene, New Hampshire Climate Adaptation Action Plan Summary Report. https://ci.keene.nh. us/sites/default/files/Boards/CCP/Keene%20Summary%20Report_ICLEI_FINAL.pdf (last accessed 2 October 2017)

City of Keene. 2010. Keene Comprehensive Master Plan. https://ci.keene.nh.us/sites/default/files/planning/ CMPprint-final-1027-fullversion_2.pdf (last accessed 2 October 2017)

The Colonial Theater. 2015. Mission & Vision. Keene, NH: True North Networks. http://thecolonial.org/about/ mission-vision/ (last accessed 2 October 2017).

EPA. 2016. What is Sustainability. https://www.epa.gov/sustainability/learn-about-sustainability#what (last accessed 20 November 2017).

Erdoğan, S., C. Cirillo, and J. Tremblay. 2015. Ridesharng as a Green Commute Alternative: A Campus Case Study. *International Journal of Sustainable Transportation*. 9: 377-388.

HCS, Home Healthcare, Hospice and Community Services. 2014. City Express.

http://www.hcsservices.org/ transportation/city-express/ (last accessed November 21 2017).

Home Health Hospice and Community Care. 2014. Bus Schedule. http://www.hcsservices.org/wp-content/uploads/2014/03/Bus-Schedule-Three-Route_Aug2017.pdf (last accessed 25 October 2017).

Home Healthcare Hospice and Community Services. 2014. City Express. http://www.hcsservices.org/transportation /city-express/ (last accessed 2 October 2017).

Kaewunruen, S. 2016. Grand Challenges in Transportation and Transit Systems. Birmingham Centre for Railway Research and Education, School of Engineering. The University of Birmingham. Birmingham, UK. https://www.frontiersin.org/articles/10.3389/ fbuil.2016.00004/full (last accessed 8 October 2017).

Katzev, R. 2003. Car Sharing: A New Approach to Urban Transportation Problems. *Analyses of Social Issues and Public Policy*. 3 (1): 65-86.

Keene State College. 2008. Carpooling Made Easy. https://www.keene.edu/office/marcom/cn/ detail/1428418358331/ (last accessed 26 October 2017).

Keene State College. 2016. KSC is First College in the U.S. to heat with Purified Waste Vegetable Oil. https://www.keene.edu/news/stories/detail/1475591460940/ (last accessed 20 November 2017).

Keene State College. 2017. Green Bikes Program Earns National Award. https://www.keene.edu/news/stories/detail/1510671571767/ (last accessed 20 November 2017).

Le Vine, S., Zolfaghari, A., & Polak, J. 2014. Carsharing: Evolution, Challenges and Opportunities. https://www.acea.be/uploads/publications/SAG_Report_- _Car_Sharing.pdf (last accessed 9 October 2017).

Li, J., P. Embry, S. P. Mattingly, K. F. Sadabadi, I. Rasmidatta, and M. W. Burris. 2007. Who Chooses to Carpool and Why? Examination of Texas Carpoolers. *Transportation Research Record: Journal of the Transportation Research Board*. 2021: 110-117.

Litman, T. 2017. Evaluating public transit benefits and costs. Victoria Transport Policy Institute. Available at: http://www.vtpi.org/tranben.pdf?b81542c0?db0c3fd8 (last accessed 9 October 2017).

Lou, F., G. Cao, K. Mulligan, and X. Li. 2016. Explore Spatiotemporal and Demographic Characteristics of Human Mobility via Twitter: A Case Study of Chicago. Applied Geography. 70: 11-25.

Monadnock Alliance for Sustainable Transportation. 2012. Action Plan. Keene, New Hampshire.

Monadnock Food Co-op. 2017. Sustainability at the Co-op. http://monadnockfood.coop/about/green/ (last accessed 2 October 2017).

Neff, J., and L. Pham. 2007. A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys. American Public Transportation Association. Washington, DC.

New Hampshire Department of Education. 2017. Green Ribbon School 2017 Honorees. https://www.education. nh.gov/news/documents/keene.pdf (last accessed 2 October 2017).

New Hampshire Employment Security. 2017. Economic and Labor Market Information Bureau, Keene, NH. Concord, NH: NHES.

New Hampshire General Court. 2004. State of New Hampshire Revised Statutes Online. http://www.gencourt. state.nh.us/rsa/html/indexes/default.html (last accessed 2 October 2017).

New Hampshire Local Area Statistics. 2017. Employment Security, Economic & Labor Market Information Bureau. Concord, NH: NHES. https://www.nhes.nh.gov/elmi/statistics/documents/laus-current.pdf (last accessed 2 October 2017).

Pitcher, F. 2015. Monadnock Trails. Jaffrey, NH: Summit Productions. http://monadnocktrails.com/ (last accessed 2 October 2017).

Rodrigue, J. 2017. Urban Transport Challenges, The Geography of Transport Systems. https://people.hofstra.edu/geotrans/eng/ch6en/conc6en/ch6c4en.html (last accessed October 8, 2017).

Schwieterman, J. P., and A. Bieszczat. 2017. The cost to carshare: A review of the changing prices and taxation levels for carsharing in the United States 2011-2016. *Transport Policy.* 57: 1-9.

Serreze, M. 2014. Northampton mayor welcomes Zipcar to downtown. http://www.masslive.com/ news/index.ssf/2014/09/zipcar_comes_to_downtown_north.html (last accessed 25 October 2017).

Shaheen, S., and A. Cohen. 2016. Carsharing Market Overview, Analysis, and Trends. *Innovative Mobility Carsharing Outlook.* Winter 2016: 1-6.

Southwest NH Guides. 2009. Downtown Keene. Keene, NH: Tourism. Available at http://www.downtownkeene. com/history.php?area=10&category_id=800 (last accessed 2 October 2017).

Southwest Region Planning Commission. 2017. Carsharing: An Alternative to Private Vehicle Ownership. Prepared report for the Monadnock Alliance for Sustainable Transportation, Keene, New Hampshire, United States.

Sullivan, E., Magid., L. 2014. Bringing Carsharing to Your Community. http://www.communauto .com/images/03.coupures_de_presse/CCS_BCCtYC_Long.pdf (last accessed 8 October 2017).

Sustainability at Keene State. 2017. Our Projects. https://www.keene.edu/office/sustain/our-projects/ (last accessed 2 October 2017).

Sustainability at Keene State. 2016. Recycling On Campus at KSC (ROCKS). https://www.keene.edu/office/sustain/ rocks/ (last accessed 2 October 2017).

Tahmasseby, S., L. Kattan, and B. Barbour. 2016. Propensity to participate in a peer-to-peer social-network-based carpooling system. *Journal of Advanced Transportation*. 50: 240-254.

The Future of Carsharing. 2017. Collaborative Fund. http://futureofcarsharing.com/ (last accessed November 19 2017).

United States Census Bureau. 2015. Millennials Outnumber Baby Boomers and Are Far More Diverse, Census Bureau Reports. https://www.census.gov/newsroom/press-releases/2015/cb15-113.html (last accessed 10 October 2017)

United States Census Bureau. 2017. Income: State Quickfacts. Washington DC: United States, U.S. Department of Commerce. https://www.census.gov/topics/income-poverty/income.html (last accessed 2 October 2017).

United States Census Bureau. 2015. Selected Economic Characteristics for Cheshire County, New Hampshire: 2011-2015 American Community Survey 5-Year Estimates. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF (last accessed 26 October 2017).

United States Geological Survey. No date. New Hampshire Landing Page. https://www.usgs.gov/science/regions/ northeast/new-hampshire (last accessed 2 October 2017).

Union Leader. 2017. Keene appoints first U.S. Bicycle Mayor. http://www.unionleader.com/Keene-appoints-first-U.S.-Bicycle-Mayor (last accessed 20 November 2017).

Veichnicki, P., Khuperkar, A., Dovey Fishman, T., & Eggars, W. D. 2015. Carsharing. Available at http://dupress.com/articles/smart-mobility-trends-carsharing-market/

Walker, M. 2013. Zipcar. Implementing car clubs: The Opportunities and Challenges. http://dru-cdn.zipcar.com/sites/default/files/car_lite_london_10_july_2014_- _opps_and_ challenges_-_zipcar-final.pdf (last accessed 8 October 2017).

Yazdanpanah, M., and M. H. Hosseinlou. 2016. The Role of Personality Traits through Habit and Intention on Determining Future Preferences of Public Transport Use. Behavioral Sciences. 7 (8): 1-15.

Zaman, H., and K. M. N. Habib. 2011. Commuting mode choice in the context of travel demand management (TDM) policies: an empirical investigation in Edmonton, Alberta. *Canadian Journal of Civil Engineering*. 38: 433-443.

Zipcar 2017. World's largest Car Sharing and Car Club Service. http://www.zipcar.com/press/releases/2014university (last accessed 25 October 2017).