Feasibility Assessment of Sustainable Transportation (FAST): Syracuse

Final Report | Report Number 19-27 | July 2019

NEW YORK STATE OF OPPORTUNITY. | NYSERDA | Department of Transportation

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Feasibility Assessment of Sustainable Transportation (FAST): Syracuse

Final Report

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NYSERDA Report 19-27 NYSERDA Contract 83182 July 2019
NYSDOT Task Assignment C-15-14

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U.S. DOT Technical Report Documentation Page

1. Report No. C-15-14	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Feasibility Assessment of Sustainable Transportation (FAST): Syracuse		5. Report Date July 2019	
		6. Performing Organization Code	
7. Author(s) Tarek Rakha, PhD, Principal Investigator		8. Performing Organization Report No. 19-27	
9. Performing Organization Name and Address Syracuse University Bowne Hall Syracuse, NY 13244		10. Work Unit No.	
		11. Contract or Grant No.	
12. Sponsoring Agency Name and Address NYS Department of Transportation 50 Wolf Road Albany, New York 12232		13. Type of Report and Period Covered Final Report, 7/2016 – 12/2018	
		14. Sponsoring Agency Code	
15. Supplementary Notes: Project funded in part with funds from the Federal Highway Administration			
16. Abstract This project aims to assess the feasibility of developing, implementing, growing, and promoting three urban mobility systems for the City of Syracuse: (1) human-powered mobility through enhancing the ability to walk and bike, (2) shared economy through carsharing and bike sharing, and (3) better integration of public transportation services. The project focuses on the mobility of the Convention District in downtown Syracuse and will integrate these systems at three scales: (1) neighborhood within the Convention District, (2) city between "innovation nodes," and (3) regional commuters from major nodes in/out of the Convention District.			
17. Key Words City of Syracuse, downtown, sustainable mobility, walkability, bikeability, sharing economy, public transit, feasibility study	18. Distribution Statement No Restrictions		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 70	22. Price

Form DOT F 1700.7 (8-72)

Abstract

This project aims to assess the feasibility of developing, implementing, growing, and promoting three urban mobility systems for the City of Syracuse: (1) human-powered mobility through enhancing the ability to walk and bike, (2) shared economy through carsharing and bike sharing, and (3) better integration of public transportation services. The project focuses on the mobility of the Convention District in downtown Syracuse and will integrate these systems at three scales: (1) neighborhood within the Convention District, (2) city between "innovation nodes," and (3) regional commuters from major nodes in/out of the Convention District.

Keywords

City of Syracuse, downtown, sustainable mobility, walkability, bikeability, sharing economy, public transit, feasibility study

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Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
CENTRO	Central New York Regional Transportation Authority
CO_2	Carbon Dioxide
FAST	Feasibility Assessment of Sustainable Transportation
FHWA	Federal Highway Administration
GHG	Greenhouse gas
GIS	Geographic Information System
LOS	Level of Service
mpg	Miles per Gallon
NACTO	National Association of City Transportation Officials
NYS	New York State
NYSDOT	New York State Department of Transportation
ppb	Parts per Billion
ppmv	Parts per Million by Volume
SUNY ESF	State University of New York College of Environmental Science and Forestry
USDOT	United States Department of Transportation

Executive Summary

This project assessed the feasibility of developing, implementing, growing, and promoting three urban mobility systems for the City of Syracuse: (1) human-powered mobility through enhancing the ability to walk and bike, (2) shared economy through car and bike sharing, and (3) better integration of public transportation services. The approach examined the social perspectives of residents regarding alternative transportation using an online survey, three focus groups, and five stakeholder interviews. Analysis of feedback confirmed automobile dependency behaviors and indicated that there was a desire for alternative transportation, including walking, biking, and use of bike and car sharing. The primary obstacles to the adoption of sustainable mobility from a societal standpoint are safety concerns, lack of sustainability culture and awareness, infrastructural challenges, perceptions of challenges for flexibility in time management, and preferences for travel using personal vehicles.

This report discusses these findings and presents respondent-based solutions for building, maintaining, and upgrading infrastructure; developing educational programs for safety awareness; and shifting policy focus areas to support alternative transport. The solutions focus on opportunities to encourage sustainable transportation at three scales: (1) within the "Convention District" in downtown Syracuse, (2) between "innovation nodes" within the city, and (3) for regional commuters outside the city into and out of the Convention District. In addition, the report discusses opportunities to leverage the forthcoming replacement of the 1.4-mile elevated I-81 viaduct that currently defines the eastern boundary of downtown Syracuse in ways that would encourage increased walking and biking, increased use of bike and car sharing, and increased use of public transportation throughout the city and beyond. Future work could replicate methods of the study in other mid-sized U.S. cities as well as develop the investigation methods to suit other communities' socio-economic experience.

1 Introduction

1.1 Project Overview

The City of Syracuse is developing into a smart, sustainable metropolitan center that exemplify the vision for "the next generation of cities," serving as "a hub of innovation, entrepreneurship and technology" (Graves, 2014). The City recently developed an Energy Master Plan that envisions a 31% reduction in average municipal vehicle fuel consumption, primarily through increased adoption of sustainable alternatives. Further, the City is in a position to leverage more than $80 million invested in recent years in four multimodal infrastructure projects: (1) the Connective Corridor, a $47.9-million investment in multi-modal transportation infrastructure (including public transportation, bike lanes, and streetscape improvements to promote walkability) along a two-mile route between the cluster of six education and health-care institutions on "The Hill" and destinations in the Downtown and the Near Westside neighborhoods; (2) the Onondaga Creekwalk, a $9.9-million, 2.6-mile bicycle/pedestrian pathway that connects the Armory Square District in downtown to the Franklin Square District, the soon-to-be-developed Inner Harbor District, and the southern shore of Onondaga Lake; (3) the Centro Transit Hub, a $18.8-million facility that replaces a former outdoor bus transfer point at the intersection of two busy streets in Downtown; and (4) a $4.5-million multi-modal transportation hub at SyracuseCoE that serves as a portal to the Connective Corridor and a testbed for emerging transportation technologies including electric vehicles. Opportunities to promote use of sustainable transportation alternatives are amplified by three additional developments in Downtown Syracuse: a rapidly growing residential community; a recently completed $57-million renovation of the historic 1924 Hotel Syracuse to serve as the primary hotel for Onondaga County's Convention Center; and the emergence of a nascent "innovation district" along Warren Street, anchored by The Technology Garden, a regional incubator for new ventures. Team personnel on this project have expertise in planning, designing, constructing, and evaluating the performance of multimodal transportation systems; greenhouse gas (GHG) modeling, qualification, accounting, monitoring, verifying, and reporting; research, development, demonstration, and deployment of clean energy innovations; entrepreneurship; and economic development.

The objective of this project was to assess the feasibility of developing, implementing, growing, and promoting three urban mobility systems: (1) human-powered mobility through enhanced and promoting walking and biking, (2) shared economy through carsharing and bike sharing, and (3) better integration of public transportation services. The project addresses the integration of these systems on three scales: (1) neighborhood within the "Convention District" in downtown Syracuse, (2) city between "innovation nodes," and (3) regional commuting from outside of the city into and out of the Convention District. The expansion of these mobility systems is anticipated to contribute to the city's GHG emission reduction goals and accelerate the development of the Convention District as vibrant neighborhood including a strong community of innovators and entrepreneurs.

2 Research Method

2.1 TASK 1: Project Management

The project was organized in five tasks. Task 1 focused on project management including the creation of a Study Advisory Committee (SAC) that met with the project team four times to review progress and provide advice on plans for future work. Members of the SAC included representatives from: Clean Communities of Central New York, the Central New York Regional Planning and Development Board, Centro, Syracuse Metropolitan Transportation Council, City of Syracuse, the Downtown Committee, and Syracuse University Department of Parking and Transportation Services.

2.2 TASK 2: Survey and Analysis of Existing Conditions

Task 2 focused on acquiring data relevant to sustainable mobility in Syracuse through: (1) examining existing research or studies pertaining to the topic; (2) completing a survey of residents, workers, and visitors of downtown; and (3) conducting a physical survey of the downtown area with a focus on the Convention District. A physical survey was conducted via photographing the streets and drawing the existing streetscape conditions in plan and section, which revealed the existing conditions and how alternative transportation is or is not supported throughout the focus area. Space allocation was highlighted so that in later design iterations the organization and prioritization of transportation infrastructure could be considered. The survey was then analyzed to determine how alternative transportation infrastructure could be integrated into the streetscapes of the Convention District.

Additionally, focus group sessions as well as stakeholder interviews were held. A total of three focus groups were conducted in downtown Syracuse, with a total of 33 participants that identified themselves as employees, employers, and residents of the downtown area. Five stakeholders were interviewed, following the same themes of the focus group discussion, but with more depth due to the nature of the one-on-one discussion. Maps were also created using GIS tools and input from the websites, including Social Explorer, U.S. Census, and American Fact Finder. The maps consider the demographics, travel trends, and existing alternative transportation infrastructure in order to analyze the design of alternative transportation and the usage of those transportation modes.

2.3 TASK 3: Develop Preliminary Programming Needs

To gain an understanding of transportation alternatives for Syracuse, research was conducted on recent literature that pertains to improving alternatives modes of transportation in cities. The literature considered in this project consisted of studies and reports that analyzed impacts of active mobility, public transportation, and transportation sharing economies in cities that are making efforts to increase mode share of sustainable transportation. This effort presented a body of work that suggested ways to successfully develop, implement, and promote transportation alternatives. The search focused on finding articles that emphasized quantitative analysis of active transportation (walking and biking), transportation sharing economies (bike sharing, ride hailing, and carsharing), public transportation, and multi-modal/comprehensive transportation alternatives (this is a more "all-inclusive" set of efforts and analyses that identifies a combination of active transportation, sharing economy, and/or public transportation). Lastly, a comprehensive plan was developed that integrates all alternative transportation systems investigated. This plan is detailed for implementation in the City of Syracuse. It includes guidelines for placement and implementation of each system to be integrated with one another and to provide sustainable intermodal mobility to the citywide community and nearby suburbs in relationship with the Syracuse Convention District. The guidelines are in the form of charts, diagrams, and maps with descriptions.

2.4 TASK 4: Preliminary Design of Multi-Modal Alternative Transportation Plan for Downtown Syracuse

Based on the studies carried out in Task 3, three scales of alternative transportation and planning focused on the City of Syracuse were identified: beyond city, city, and downtown. The multi-scaled approach was based on the intention of connecting Syracuse internally while also creating efficient and productive links to the neighboring districts. Design considerations for specific streets and zones within downtown Syracuse were developed, and other design considerations that can be applied on a broader scale throughout the downtown area as a whole, specifically looking at intersection design. The downtown area of Syracuse is the focus of neighborhood-scale design, a design with small blocks, mixed-use development, and short distances between destinations to create areas that foster biking and walking—especially when compared to the suburban sprawl of post-war developments. The intention in this subtask was to develop plans for a downtown area that could not only attract more students and visitors, but also encourage people to relocate from their suburban neighborhoods to increase density and further promote walkability. The city-scale plan addressed mobility issues throughout the City of Syracuse. Two plans were developed—one short-term, proposing solutions for immediate implementations and the other

to take place across a longer time frame. These plans offer design proposals encompassing bike sharing and car-sharing economies as well as e-biking. The main concept for the planning and organization of the city follows the idea of "innovation nodes," centralized locations based around institutions that provide resources to innovators and entrepreneurs.

2.5 TASK 5: Projected Impacts and Financial Feasibility Assessment

A field survey was conducted using photography and observations to document current infrastructure conditions and typical usage patterns in the Syracuse Convention District. Roadway alignments and characteristics were measured in the field and documented. An evaluation of the existing use of bicycles and occurrence of walking was conducted for the study area, utilizing the Bicycle & Pedestrian Level of Service Models, based on the respective data collected. These models, which have been applied to hundreds of thousands of miles of roads throughout the United States, are fundamental performance measures and design tools in the Highway Capacity Manual (HCM, 6th Edition). Benefits of the three transportation scenarios presented the by the team were assessed and represent varying degrees of smart growth. The elements of smart growth integrated into each recommended planning scenario can produce a variety of benefits—from increased walkability, improved public transport access, and changes that promote better conditions for cycling and bike share. The task also highlighted marketing approaches for alternative transportation developed by members of the National Association of City Transportation Officials (NACTO).[1] First, the section discusses the Alternative Transportation Promotion efforts of the cities, and second, the section is broken down into different marketing efforts, including: Online Programs, Community Input, Wayfinding, Graphics Effort, Partnerships, Competitions, Artists Relationships, and Grass Roots Efforts. These categories cover the different marketing efforts that the cities created and how those efforts interacted with the inhabitants and workers of each city. Cost and potential funding sources for possible implementation were surveyed. To conclude the project, a detailed plan was presented in the form of a class taught at Syracuse University. The class, with contributions from 15 students organized into five groups, developed the introductory approach to the design in total, and each group tackled a design scale.

[1] The National Association of City Transportation Officials (NACTO) is an association of North American cities and transit agencies. Founded in 1996, NACTO's mission is to "build cities as places for people, with safe, sustainable, accessible and equitable transportation choices that support a strong economy and vibrant quality of life" (see https://nacto.org/about). NACTO members collaborate to produce design guides, conduct training and workshops, and develop priorities for priorities for city transportation in state and federal legislation and regulation.

3 Findings and Conclusion

3.1 TASK 2 Conclusions—Survey and Analysis of Existing Conditions

Syracuse as a city relies heavily on single-occupancy vehicular travel, with less than 3% of all trips in the city made by alternative modes of transportation (New York Power Authority, 2015). Onondaga County residents drive almost 7.5 miles a day more than their statewide counterparts and Syracuse metropolitan area residents drive more miles per capita than any other metropolitan area in the New York State (N.Y. Works, 2013). Yet the city has a goal of reducing its municipal vehicles' greenhouse gas emissions 31% by 2050; this can be achieved through a few efforts, of which the implementation of alternative transportation infrastructure in the city is primary (New York Power Authority, 2015).

Innovation Districts are urban sites that educational institutions, businesses, and governments in partnership invest in an effort to redevelop the area and fuel economic growth (Sharma, 2012). The Convention District in downtown Syracuse is nascent innovation district because it includes The Technology Garden (TTG), which provides resources for new ventures, and several growing new ventures have established offices nearby; this cluster of activity is recognized as having the potential to attract real estate development and foster technology and municipal and civic advancements (Central New York Regional Economic Development Council, 2015-2016). Transportation investments are an important element in successful innovation districts because they give people access to the redeveloping area—access that is sustainable.

The Long-Range Transportation Plan found that Syracuse residents believe that the most significant transportation project in the metropolitan area is the I-81 Viaduct Project, followed by an enhanced transit system (Syracuse Metropolitan Council, 2015). The alternative design options for the I-81 Viaduct will strongly impact the transportation of downtown Syracuse and alternative transportation mobility is a primary consideration in the design process for I-81 (Federal Highway Administration, 2015).

The City of Syracuse Comprehensive Plan 2040 covers the plans for development and infrastructure investment in the City of Syracuse, including a Bicycle Plan and Land Use & Development Plan (Common Council, Planning Commission. City of Syracuse Comprehensive Plan 2040, 2012). The Bicycle Plan proposes 2.4 miles of bike lanes for downtown Syracuse based on road infrastructure

assessments and priority network connections (Common Council, Syracuse's Comprehensive Plan 2040: Bicycle Plan, 2010). The Land Use & Development Plan highlights the downtown area as a dense mixed-use urban core in need of a strong transportation network that will encourage alternative transportation modes into the area as well as (and especially) encourage pedestrian mobility within the area.

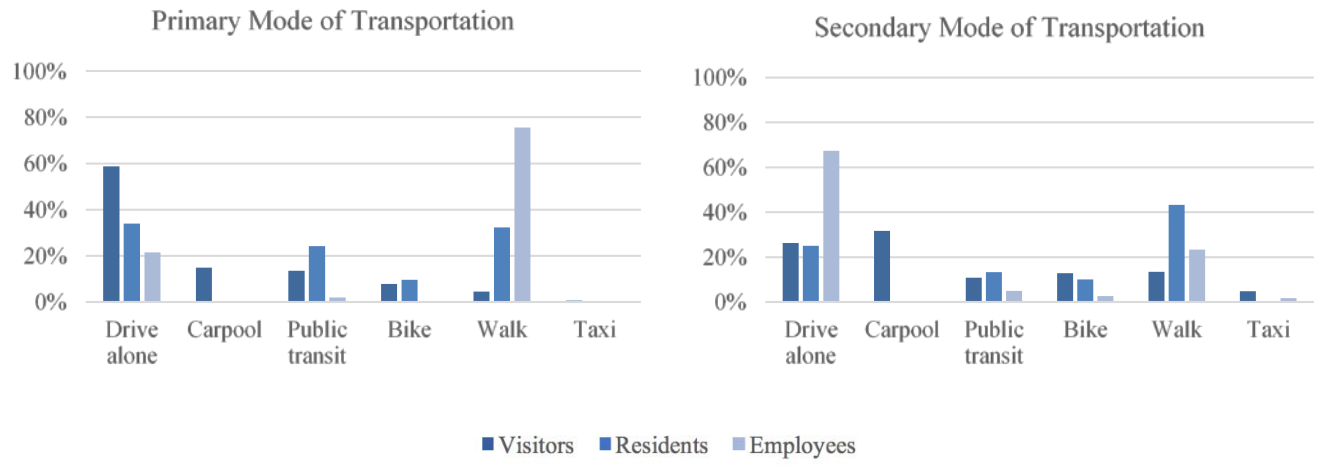
Over 90% of downtown employees arrive via car and park in the 18,229 downtown parking spaces, of which the on-street parking is at 90% capacity and the off-street is at 80% capacity (C&S Companies, 2008). However, 31% of employees say they would like to use alternative transportation modes more often, and employers believe that employee recruitment is negatively impacted by the transportation system (UrbanTrans North America and IBI Group, 2011). An up-to-date survey of employees and employers in addition to residents and visitors of the downtown area helped the FAST: Syracuse team determine what alternative transportation infrastructure would be of most interest and what infrastructure would change commuting habits so as to reduce greenhouse gas emissions.

The implemented FAST: Syracuse survey collected data on (1) the current mobility trends in downtown Syracuse and the (2) interest in potential alternative transportation infrastructure investments. The data was analyzed as a starting point for focus groups and stakeholder interviews. The survey was available online from August to December 2016, and focused on downtown Syracuse geographically, including current and potential mobility trends within, and commuting into the area. The area is considered the urban region bounded by I-81, I-690, Onondaga Creek, and East Adams Street (Figure 1). Four different categories of people were surveyed: 365 employees, 168 visitors, 71 residents, and 16 employers. Of the respondents, 62% were female, 36% were male, and 2% did not identify as either female or male The age groups were a broad range: 9% were 18–24 years old, 15% were 25–29 years old, 24% were 30–39 years old, 18% were 40–49 years old, 23% were 50–59 years old, and 11% were 60 plus years old. Twenty-five percent of the respondents lived within the City of Syracuse, and 62% lived within Onondaga County outside of the city limits;13% did not identify as living in either in Onondaga County or within the City of Syracuse.

Figure 1. Syracuse Downtown, Highlighting the Preliminary Study Area

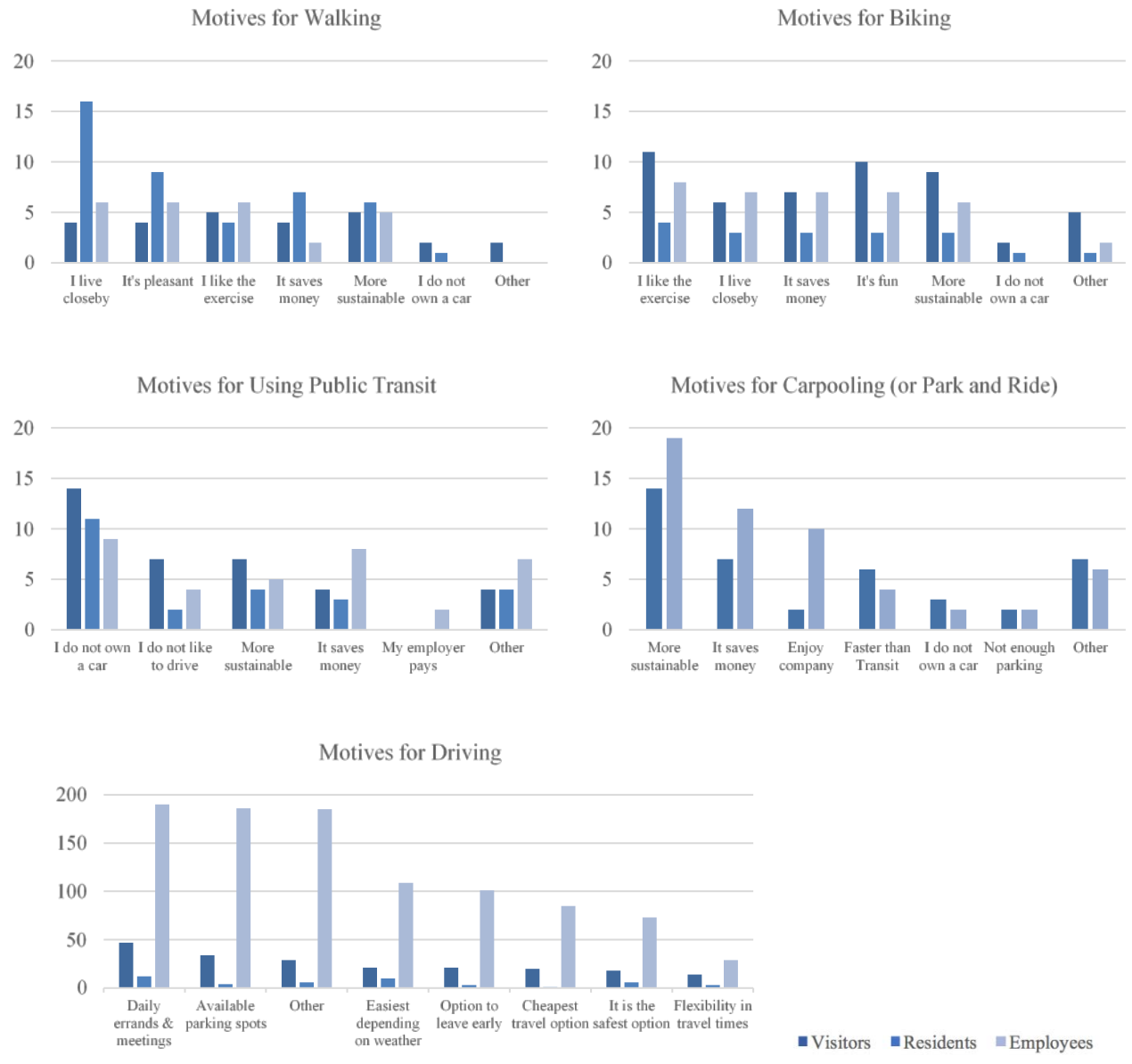
Visitors, residents, and employees were asked about their primary and secondary transportation modes within downtown Syracuse; responses are shown in Figure 2. These questions provided existing mobility-trend information for the neighborhood based on respondents' relationships to the downtown area. Of note is the high percentage of employees who chose to walk within downtown and the high percentage of visitors who chose to drive alone or carpool to or within the area. However, 83% of employees reported that they drive alone to work.

Figure 2. Survey Respondents' Primary and Secondary Mode of Transportation



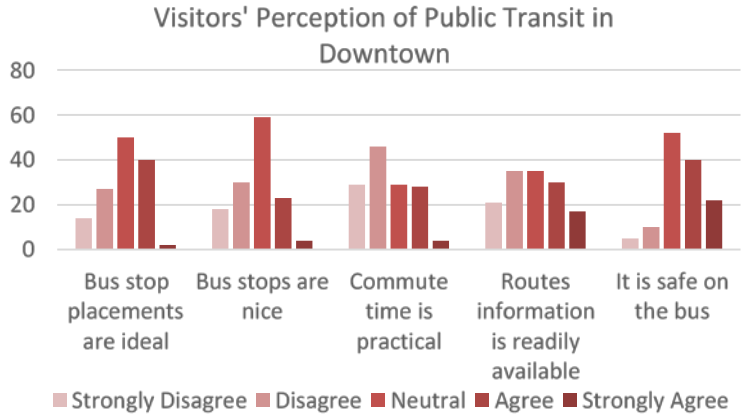
Once respondents stated how they travel, the survey asked about motives for their choice of a specific mode of transport; results are shown in Figure 3. Walking was often chosen due to convenience or pleasure; biking for a broader range of reasons; public transit out of necessity, rather than choice; and carpooling as a practical decision to save money or to be sustainable. The most popular reason to drive was for the option to run daily errands or go to meetings; however, when employee respondents were asked how many trips they usually make during the day, the response average was 1.35 trips only. Additionally, the second least popular answer for driving was because it is the safest option, yet, as will be later discussed, many residents state they do not walk or bike because they regard it as unsafe.

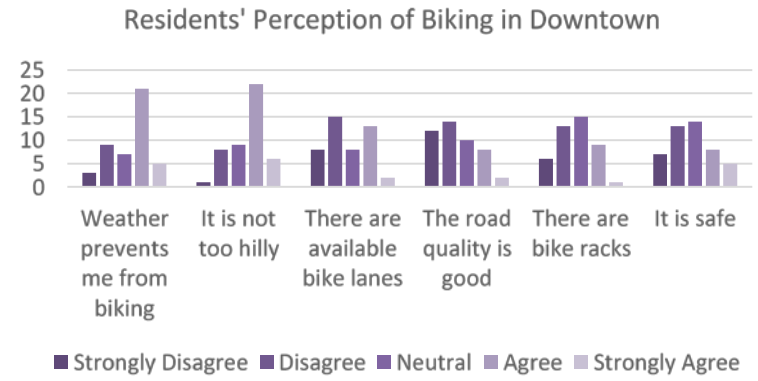
Figure 3. Mode Share Motives per Number of Survey Respondents

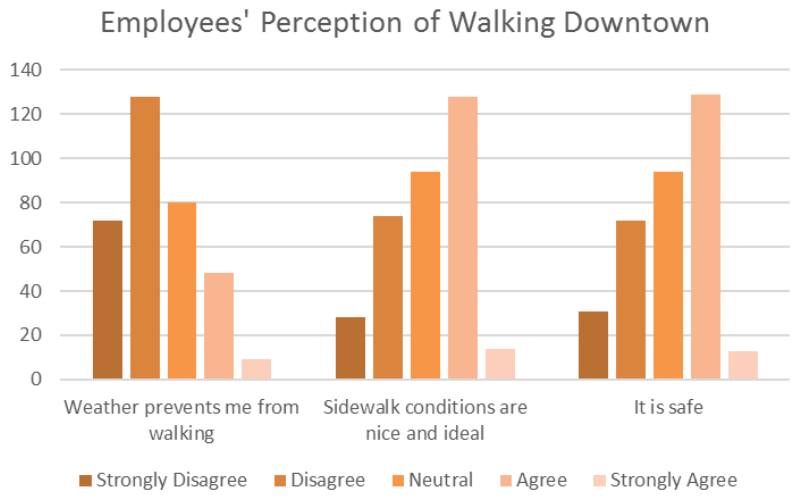


All respondents were asked about their perceptions of existing options for alternative transportation within Syracuse, no matter their personal transportation mode choice. The responses were relatively similar within each category. Representations from each question were chosen and presented (Figure 4). Public transit perception is relatively neutral, yet safety seems to be of critical concern. Weather and hills do not prevent respondents from biking. Walking within downtown was well recognized as well.

Figure 4. Alternative Transportation Perceptions per Number of Survey Respondents

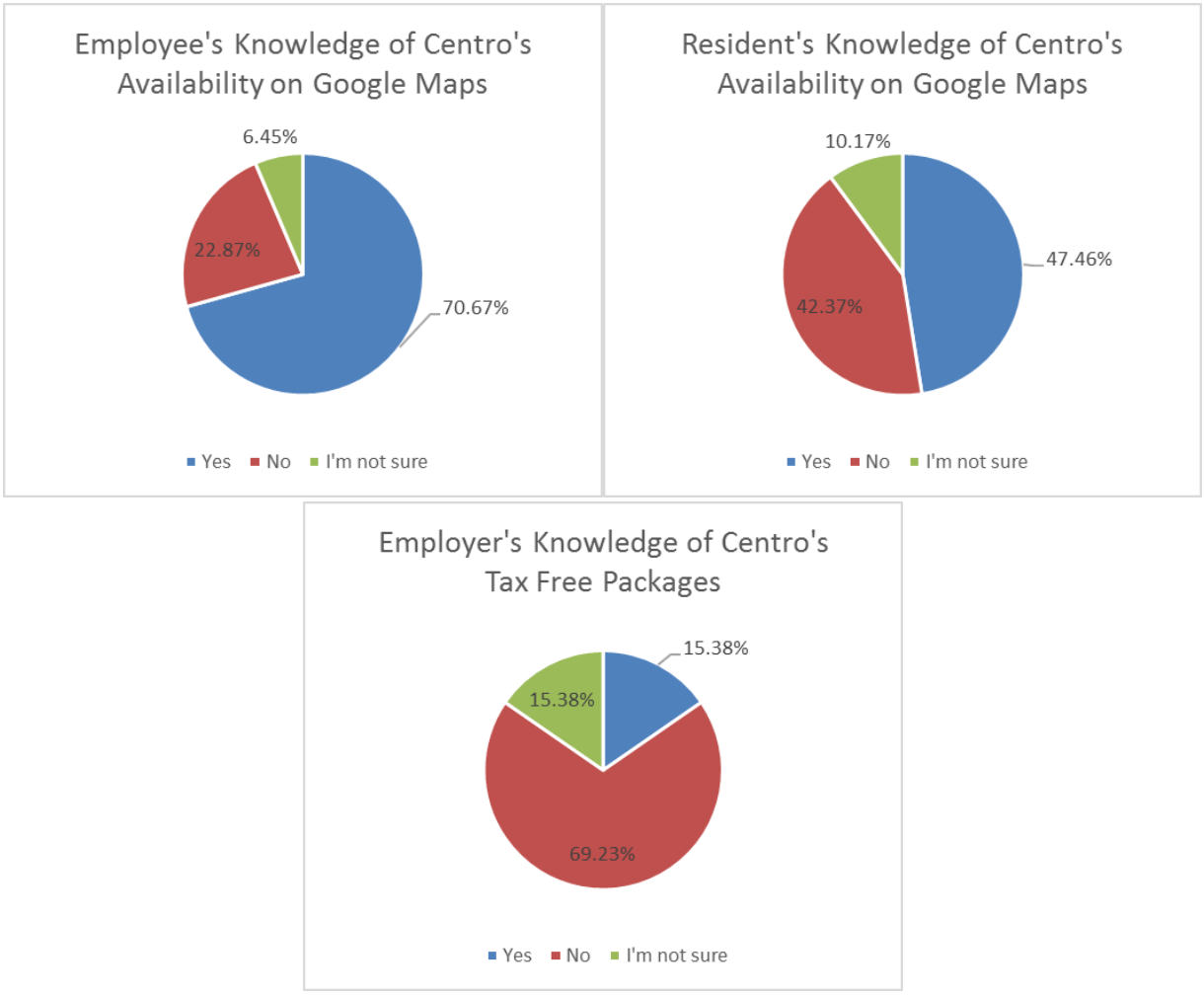






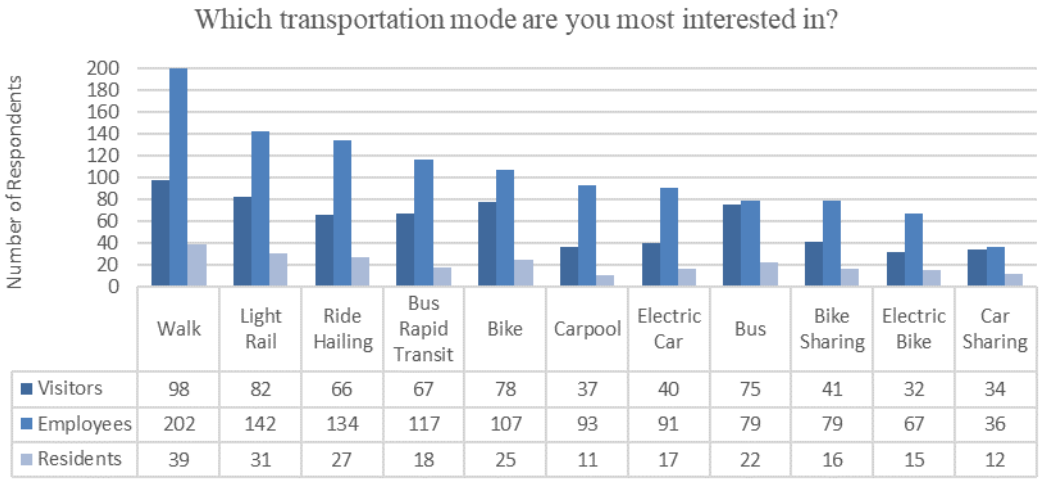
CENTRO, the public bus system for Syracuse, has a few initiatives that are considered efforts or incentives to make it easier to take the bus. Two examples of this are (1) CENTRO's routes are now available on Google Maps, which makes trip planning easier, and (2) CENTRO offers tax-free packages to employers to help support employees in riding the bus. More than half of the respondents did not have knowledge of these initiatives (Figure 5).

Figure 5. Knowledge of CENTRO's Availability on Google Maps and CENTRO's Tax-Free Packages



All respondents were asked to identify the alternative transportation mode that most interested them. Walking was the most popular response for all three groups. Additionally, light rail, despite its unavailability in Syracuse, was often the second most popular response. Lastly, when employers were asked why they would choose to support alternative transportation programs, the most popular answer was to help development within downtown, recognizing that alternative transportation cultivates a lively neighborhood.

Figure 6. Interest in Modes of Alternative Transportation per Number of Survey Respondents



	Walk	Light Rail	Ride Hailing	Bus Rapid Transit	Bike	Carpool	Electric Car	Bus	Bike Sharing	Electric Bike	Car Sharing
Visitors	98	82	66	67	78	37	40	75	41	32	34
Employees	202	142	134	117	107	93	91	79	79	67	36
Residents	39	31	27	18	25	11	17	22	16	15	12

The photographs of streets, intersections, and drawings as well as plans and sections, reveal that the primary transportation infrastructure invested in throughout downtown Syracuse is for vehicular traffic and parking. Bus infrastructure is limited to shelters at some CENTRO bus stops. However, if a priority network is developed, the area has potential space for dedicated bus lanes that would allow for quicker public transit travel.

Portions of Fayette Street, E. Genesee St., and E. Water Street are the only roads with designated bike lanes. Another street has sharrows; however, the shared-lane markings have been proven more dangerous than good for bicyclists. To say the least, the Convention District currently is challenged when it comes to bicycle infrastructure. One way to remedy this problem would be to take advantage of the 12-foot wide lanes. If car traffic lanes were converted to 10 feet, as recommended by NACTO, every street would have at least 4 feet available for bike lanes. Additionally, on-street parking could be removed to gain space for the bicycle infrastructure.

As for pedestrian infrastructure, most streets have sidewalks in the Convention District. Typically, the major streets have a sidewalk, street furniture zone with trees (but no seating available), lampposts, trash can space, and concrete pedestrian through zones for walking spaces and entrances to buildings. The minor streets are mostly devoid of streetscape features that make walking more enjoyable and attractive. The intersection photos show a lack of consistency in pedestrian crosswalks that could be streamlined along with traffic signals to make travel in downtown more efficient and clearer to users.

Although members of the focus groups enthusiastically identified as being "walkers" for health, efficiency, and economic reasons, they all shared a number of concerns, which included: safety (poor lighting, fear of being accosted by loiterers and panhandlers), construction, reckless driving, adverse weather conditions, pavement conditions, and poor infrastructure. These factors contribute to an unhospitable impression for pedestrians in the downtown area. The discussion of safety revealed that women felt more unsafe than men especially around panhandlers and in unlit areas. A few female members of the focus groups shared personal experiences in which they were targeted and harassed because of their gender, and the men in the groups voiced concern for female acquaintances. The interviewed stakeholders' main suggestions for walking infrastructure was to make streets more appealing and to create more wayfinding tools. To make the streets safer, a number of residents thought that general renovations or adding lighting would help. A comparison of safety was made between downtown Syracuse and the Connective Corridor route, connecting Syracuse University's main campus and downtown. Wayfinding was suggested in terms of helping people after dark when it is difficult to see a map to find cultural hubs and to explore downtown, especially for visitors. The stakeholders were relatively split on the idea of a wayfinding map, mainly because residents already have a knowledge of Syracuse.

Employees and employers agreed that the outer ring of downtown Syracuse alienates pedestrians with its strips of decrepit parking lots and lack of intriguing architecture and public space, whereas the focus group preferred historic architecture and inviting shop fronts. In addition, they believed the city's highways contribute to a disconnect between neighborhoods, highlighting that pedestrian walkways do not bridge the gap to reduce the feeling of isolation. Residents of downtown Syracuse stated that the neighborhood offers many walkable destinations, but they were discouraged from walking by the weather and the conditions of the sidewalk. Residents conveyed that the sidewalks are constructed poorly, and with inadequate drainage, pedestrians are often forced to deal with large puddles. In the wintertime, snow is not cleared often enough, and pedestrians must risk their safety to walk on the road. A resident of downtown Syracuse with a disability stated that the poor sidewalk conditions further limits her mobility. The city's prioritization of cars over pedestrians irked residents who felt that someone needs to be held accountable for the deficient maintenance and inadequate clearing of sidewalks. Even in inclement weather, residents still choose to walk or take the bus as opposed to driving.

After an introduction to the successful pedestrian culture in Portland, Oregon, the employer and employee focus groups clarified that they felt Syracuse already had similar assets in place to encourage walking. The residents of downtown disagreed with the employee and employer focus groups, however. Residents felt that Portland's initiatives are not feasible for Syracuse because of the difference in climate and culture. As opposed to Portland, most Syracuse businesses close fairly early in the evening resulting in empty streets and lack of incentive for walking in the evening. One interviewee pointed out that downtown has two completely different ambiences during the week: Monday through Friday nine to five (office hours) and non-office hours. Another pointed out that space in general is a problem within downtown, which prevents the addition of any pedestrian amenities. Syracuse was also criticized for having a less sanitary street environment and higher crime rates, which attribute to a lack of interest in walking. Yet, all three focus groups agreed that a lack of awareness and promotion was detrimental to the creation of a pedestrian-centric transportation culture. All groups also responded positively to employer-provided incentives for walking, although they showed concern for the reduced parking spaces.

All three focus groups agreed that biking in the summer is enjoyable and manageable even without necessary infrastructure but were hesitant to consider biking in the winter. A lack of bicycle infrastructure in the form of bicycle racks, park and ride lots, and cohesively marked routes discouraged participants from riding bikes. The hilly landscape and cracked paving are also a significant deterrent, with some hills that are too steep for the average person and deteriorations like cracks and potholes only adding to the difficulty. In addition, residents felt that the urban fabric of Syracuse was designed to enable car use, whereas the typology of European cities was more conducive to cyclists and pedestrians due to narrow winding streets, less highway infrastructure, and less parking availability. The affordability of biking was seen as an incentive, although additional incentives such as a shared "office bike" would further encourage employees to ride bikes. One interviewee suggested incentives for bicycling to help convince people to bike more. Additionally, they thought a bike sharing program within downtown would be helpful especially for suburban residents to travel within downtown for work.

In addition to infrastructure and incentives, the focus groups communicated concern about driver education, and on how to safely share the road, which is imperative to the cultural acceptance of alternative transportation. Currently, drivers in Syracuse who do not take pedestrians and cyclists into consideration while driving greatly add to the unpleasant and dangerous conditions. The solution suggested by interviewed stakeholders was for controlling the speed of cars and creating more room for bicyclists, mainly by removing parking on the streets. Other suggestions included education on bicycling, especially in the schools and universities of Syracuse.

When discussing alternative transportation, the conversation quickly turned to ride hailing services such as Uber, as the focus groups agreed they would rather use ride hailing services that are cheaply priced as opposed to biking or walking, especially during winter months. Residents also felt there was a lack of integration between alternative transportation means as well as comment on how the public bus system should be supplemented by bike sharing.

With the frequent discussion of ride hailing, all focus groups mentioned frustration with legislative barriers to companies such as Uber.[2] Uber was specifically described as a possible economic boost to the downtown area by providing visitors and residents with a familiar and affordable method to frequent nightlife. The focus groups agreed that ride hailing is a safe, economical, and appealing method of alternate transportation. Of the three methods discussed, ride hailing received the most positive response. Responses included promises that ride hailing would without a doubt allow residents to leave the car at home (100%) and would decongest traffic during events and concerts.

Bike sharing was met with enthusiasm due to affordability. Carsharing was also met with moderate enthusiasm that was abated with the realization that most employees currently ride their personal cars to get to work and have no reason to switch to carsharing. Although other employees mentioned that having their company reimburse the costs of gas would make them more likely to take advantage of carsharing services. Carsharing was recognized by interviewees as a system that often works and could help cultivate a green economy in Syracuse. However, the stakeholders also stated that car-sharing systems, like ZipCar, are more about individual uses and have a smaller market. ZipCar was perceived as a service used on the weekend for small errands, not habitually such as commuting to work. The focus groups were in agreement on wanting the city to encourage alternative transportation in the form of citywide and government-supported incentives for car, bike, and ride sharing.

Participant perception of public transit viewed the current design of CENTRO Bus routes as not encouraging ridership due to the excessively frequent stops and expanded routes that inflate travel times to the point that walking is faster. One member of the focus groups lamented that monthly access to a parking garage is cheaper than bus fare. This could be linked to employers being unaware of incentive programs provided by CENTRO aimed at employees who commute. Another concern

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[2] The focus groups were held in September 2016; at the time, ride-hailing services were not legal in the Syracuse or elsewhere in Upstate New York. In June 2017, the New York State Legislature passed legislation authorizing ride-hailing service in Upstate New York; the legislation was signed by Governor Andrew Cuomo and became effective June 29, 2017.

was that CENTRO was not fulfilling demand over the weekend by not providing enough buses, limiting transportation choices that allow residents to enjoy Syracuse destinations on their days off. Residents expressed dismay at the lack of public transportation in the outer area of Syracuse, which made accepting career opportunities in that area less appealing. Across focus groups it was agreed that greater collaboration between employers and CENTRO is necessary, specifically in scheduling buses in accordance to work schedules. CENTRO's effort to make bus routes more available to patrons by being included in Google Maps has only deterred some riders in the focus groups, because it informs riders of the congested travel times. Suggestions from interviewed stakeholders include an incentive system for CENTRO that would get more residents riding the bus. If there were discounts or rewards, some stakeholders believe more people would ride the bus. Additionally, it was suggested that CENTRO partners with more businesses to support that idea.

In addition to the investigation methods previously discussed, the focus groups were asked what other transportation modifications they would like to see in their city. Multiple participants mentioned a desire for a light rail system while acknowledging the possible infeasibility. Stakeholders presented different ideas about a future scenario in Syracuse in which alternative transportation is more prevailing or successful. Foremost, the suggestion was to invest more in alternative transportation and complete proposed projects (such as the Syracuse Bicycle Plan) for the city. It was recognized by the interviewees that this would require a change in infrastructure investment within the city and with it a general attitude change. Additionally, there is interest in creating more safe and appealing streets for pedestrian safety and interests.

3.2 TASK 3 Conclusions—Develop Preliminary Programming Needs

Literature Analysis (Multi-modal/Comprehensive Transportation Alternatives): Nordfjærn et al. (2016) conducted a study among urban Norwegians with car access to understand the perceptions of modal alternatives. It was found that public transport use as an alternative correlated with demographic information. For example, those above 30 years old with a basic level of education and a low annual gross income thought that the public transportation was a likely alternative. Practical barriers seemed most important for considering active transport as a likely alternative. Table 1 shows an example of a chart that clusters Norwegians by certain demographics and their perceptions of modes.

Table 1. Perceptions of Transportation Alternatives Based on Demographic

From Nordfjærn, T., Simsekoglu, Ö., & Rundmo, T. (2016). Active transport, public transport and electric car as perceived alternatives in a motorized Norwegian sample. Transportation Research Part F, 6.

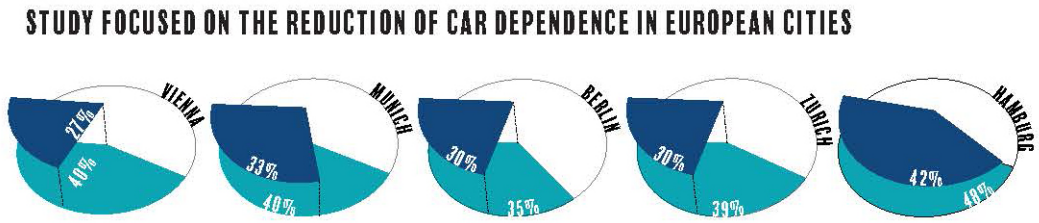
Demographics in the perceived transport alternative clusters.

Indicator	Public transport (n = 139) (%)	Active transport (n = 214) (%)	All modes, but especially electric car (n = 230) (%)	Only electric car (n = 154) (%)	χ^2
Male	45	44	43	60	11.79**
Age < 30 years	12	25	15	14	13.32**
Basic education	42	31	26	31	10.52*
Annual gross income at 42 000 € or below	64	60	51	51	8.42*
Annual motorized car mileage of 10 000 km or less	64	60	51	51	29.34***

*** $p < .001$.
** $p < .01$.
* $p < .05$.

Another study focused on the reduction of car dependence in European cities found that successful cities over a 25-year period reduced car use by implementing an integrated and coordinated set of policy changes, interventions, and efforts targeted toward reducing the speed of car travel, the convenience of car use, and costs of use. Meanwhile, these interventions tried to increase safety and convenience of active and public transportation. Five cases that studied European cities all showed improvement over a period of 25 years; carshare of trips reduced from 40% to 27% in Vienna, 40% to 33% in Munich, 35% to 30% in Berlin, 39% to 30% in Zurich, and 48% to 42% in Hamburg (Buehler, et al. 2016).

Figure 7. Carsharing Reduction on Car Dependence



In Promoting Walking and Cycling as An Alternative to Using Cars: Systematic Review, Ogilvie (et al. 2004) studied the effectiveness of various interventions aimed at deterring car use and encouraging other modes of transportation. The most effective intervention was a targeted behavior change program which changed behaviors by offering tools and guides to groups, as well as individualized user needs. For example, in Perth, Australia, a 'TravelSmart' program gave households, "...a tailored selection of resources such as leaflets, timetables, maps, and free trial bus tickets," which led to a 5.5% shift of household trips from car to active transportation. Figure 9 provides a visual of various intervention methods and their effectiveness.

A study released in 2015 showed that, over a 20-year period, a number of single occupancy cars was reduced due to sustainable transport infrastructure investments made in Boulder, Colorado (Henao, et al. 2015). Single occupancy vehicle use decreased 9.9%, compared to the national average of 2.9% over the same period. Active and public transport usage increased 8.5%, versus the national average of only 1.1%. Table 2 shows a simple graphic that clearly exhibits the connection between mode share trends and cumulative investments.

Table 2. Chart of Intervention Effectiveness Worldwide

Summary of evidence of effectiveness of interventions to promote modal shift

From Henao, A., Piatkowski, D., Luckey, K. S., Nordback, K., Marshall, W. E., & Krizek, K. J. (2015). Sustainable transportation infrastructure investments and mode share changes: A 20-year background of Boulder, Colorado. Transport Policy, p. 70.

			Evidence for shift from cars towards walking and cycling*			
Study	**Validity score**	**Nature of comparison**	**Significant positive effect**	**Positive effect of uncertain significance**	**Inconclusive or no effect**	**Negative effect of uncertain significance**
Targeted behaviour change programmes						
Glasgow[w1 w2]	9	Controlled	Yes	—	—	—
Perth, Australia (TravelSmart)[w3-9]	7	Controlled	Yes	—	—	—
Frome (TravelSmart pilot)[w10]	9	Controlled	—	Yes	—	—
Gloucester (TravelSmart pilot)[w11]	9	Controlled	—	Yes	—	—
Århus[w12-14]	7	Uncontrolled	—	Yes	—	—
Adelaide[w15-18]	4	Uncontrolled	—	—	Yes	—
Publicity campaigns and agents of change						
Camden-Islington[w19]	8	Controlled	—	—	Yes	—
Maidstone[w20]	7	Controlled	—	—	Yes	—
Phoenix[w21]	5	Uncontrolled	—	Yes	—	—
Eugene[w22]	4	Uncontrolled	—	—	Yes	—
Engineering measures						
Delft[w23-30]	7	Controlled	—	Yes	—	—
Detmold-Rosenheim[w31-33]	6	Uncontrolled	—	—	—	Yes
Stockton[w34]	5	Uncontrolled	—	—	—	Yes
England (20 mph (30 km/h) zones)[w35]	5	Uncontrolled	—	—	Yes	—
Boston[w38-40]	4	Uncontrolled	—	Yes	—	—
England (bypasses)[w36 w37]	3	Uncontrolled	—	—	—	Yes
Financial incentives						
California (cashing out)[w41 w42]	8	Controlled	Yes	—	—	—
Trondheim[w43 w44]	7	Uncontrolled	—	—	—	Yes
Providing alternative services						
San Francisco[w45-47]	7	Controlled	—	—	Yes	—
Voorhout[w48]	7	Uncontrolled	Yes	—	—	—
California (telecommuting)[w49]	4	Controlled	—	—	—	Yes

*No studies had significant negative effects.

Heidi Garrett-Peltier's study on the impacts of pedestrian and bicycle infrastructure on employment suggests that issues in the U.S. regarding high unemployment, unsustainable energy use, and national obesity epidemic can be "…partly addressed through walking and cycling." The research team found that on average there was a correlation between transportation infrastructure projects and number of jobs created. Notably, bicycle-only infrastructure created the most jobs, 11.4 jobs were created per $1 million in infrastructure investments when considering in-state effects (Garrett-Peltier 2011, 9).

3.2.1 Walking

Oswald Beiler and Phillips (2016) write about the need for a streamlined process for prioritizing pedestrian infrastructure improvements. They create the pedestrian corridor improvement index (PCII), which is a quantitative analysis and decision-making tool. They argue that, currently, local approaches lack federal guidance. An example of the use of the PCII is a case study of Union County, Pennsylvania, where four pedestrian corridors (paths) (two in Lewisburg Borough, and two in East Buffalo Township) were selected for a case study area to decide which level of priority they should have in regard to improvement funding.

3.2.2 Bicycling

In Making Cycling Irresistible: Lessons from the Netherlands, Denmark, and Germany (2008), Pucher and Buehler explain how these countries are most successful in increasing bicycle mode share. These countries invest in bicycle infrastructure mainly by creating separate bike paths and facilities that support safety and stress-free bicylcing, especially for children, women and the elderly. Additionally, the importance of route practicality was emphasized, highlighting routes for daily destinations like work, school, and shopping along heavily traveled roads, as opposed to solely recreational routes.

Fields (et al. 2013) describes a study in Minneapolis which found that new bike facilities increase the number of cyclists and that by adding more and improved bike facilities over time, a city will continue to increase its number of cyclists. Based on bike count sites, it was found that paths which were new or improved in some way attracted more cyclists than those which remained unchanged. Findings suggest that policy which encourages continued community investment in bicycle paths should be supported.

Spencer (et al. 2014) elaborates on this and argues that bicycle safety and comfort can and should be improved by and through policy changes. Based on their findings in a Burlington, Vermont study, they "…recommend that policy changes target bicycle safety on roadways in a variety of conditions, which can mitigate safety concerns regarding lighting, plowing, and snow and ice buildup" (30). In other words, changes to bike culture and infrastructure in a specific place must be tailored to local needs. Safety concerns in Burlington, Vermont are different than those in Fort Lauderdale, Florida, for example. In Infrastructure, Programs, and Policies to Increase Bicycling: An International Review (2010), Pucher, Dill and Handy add that the most effective way to increase a city's number of cyclists is to implement a comprehensive effort. They explain, "The cases reviewed here suggest that a comprehensive approach

produces a much greater impact on bicycling than individual measures that are not coordinated" (S122). Table 5 provides a very detailed chart of 14 case study cities in which trends in bicycle levels and safety are compared to a number of implemented interventions (e.g., Berlin quadrupled the number of bicycle trips between 1970–2001, S117). Bike policy changes must then be ongoing, site specific, and comprehensive.

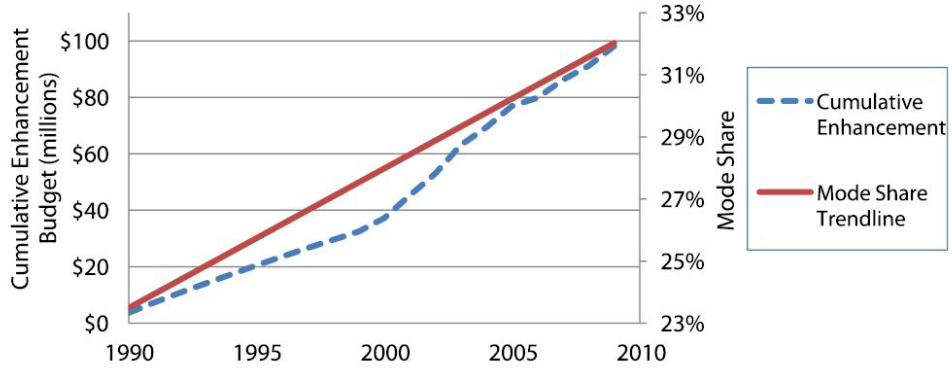
3.2.3 Transportation Sharing Economies

The introduction of a bike share program alone cannot reduce car use. Policy changes must also occur to promote bike share as a likely alternative to single-occupancy mode share users. In a survey conducted on car users that do not utilize Brisbane's CityCycle bike share program, the drivers were asked reasons for not utilizing the bike share system. The top reason resulted in "Driving is more convenient" (Fishman, Washington and Haworth 2014). See Figure 9 for comparison with other reasons.

Figure 8. Boulder Alternative Mode Share Trend Over 20 Years

Combined (pedestrian, bicycling, and transit) cumulative enhancement budgets and combined mode share in Boulder, 1990-2009

From Fishman, E., Washington, S., & Haworth, N. L. (2014). Bikeshare's impact on car use: evidence from the United States, Great Britain, and Australia. Proceedings of the 93rd Annual Meeting of the Transportation Research Board.



The survey suggests in order to reduce car use amongst this population, an effort should be made toward "...policy changes that seek to increase the competitive advantage of bike share over the convenience of car use, improving perceptions of rider safety, and providing docking stations in close proximity to home and work" (11). Later in a 2015 review of recent literature, Fishman found that bikesharing still does not show significant offsets of car use. Other key findings from this review are that convenience plays as a major factor in attracting bike share users and also that demographics of bike share users tend to be urban dwelling white males with higher than average incomes and education (11). In relation to the study done

in Exploring the Equity Dimensions of US Bicycle Sharing Systems, Smith, Oh and Lei identify this trend within the US bike share market and suggest that even though diverse communities are currently embracing active transportation "…there is a valid concern that traditionally underserved populations will again be marginalized or unable to share in the full benefits of existing and future bicycle- and pedestrian-oriented planning efforts," such as bike share programs (5).

3.2.4 Public Transportation

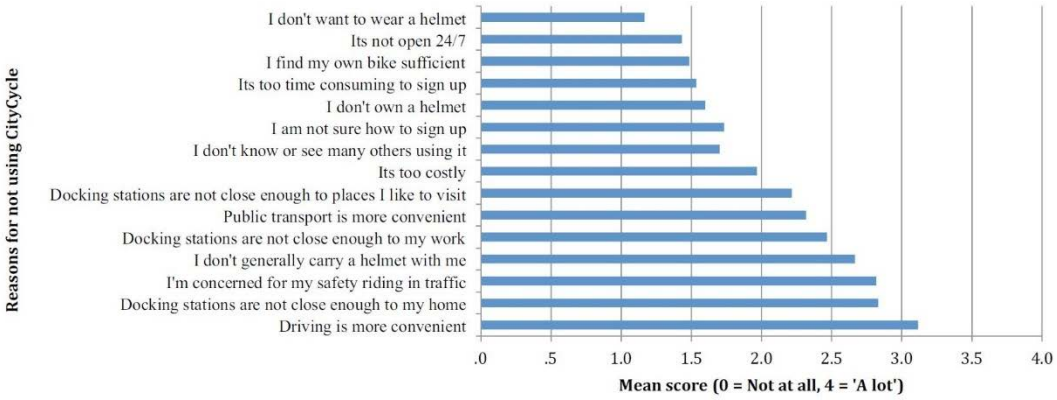
For the purposes of this study, public transportation methods will include bus transit networks and light rail transit networks.

Based on two studies (Litman, Evaluating Public Transit Benefits and Costs: Best Practices Guidebook 2015; Hensher, Ho and Mulley, Identifying preferences for public transport investments under a constrained budget, 2015), light rail was found to be perceived as the most effective and a preferred mode of public transportation. In order to improve public transit options, light rail is a preferred investment over bus rapid transit because of its perceived higher quality solution to transit problems, even with known budget constraints (Hensher, Ho and Mulley 2015). In Evaluating Public Transit Benefits and Costs: Best Practices Guidebook (2015), Litman explains how current methods for evaluation of public transit methods fail to provide a comprehensive image. He explains that "Conventional transport economic evaluation tends to overlook and undervalue many transit benefits [because they were] developed to assess roadway improvements and focus primarily on vehicle travel speeds and operating costs" (2). This guidebook is particularly important when making decisions about public transit for our project because Litman provides a thorough list of factors that should be considered in a cost-benefit analyses of public transit (3), as well as a visual for public transit benefit and cost categories (110). He continues to argue that the evaluation of public transit can influence its perceived value (111), which is an important part of influencing policy.

Figure 9. Reasons for Not Joining CityCycle Bikesharing in Queensland

If you were considering joining *CityCycle*, to what extent would these factors discourage you?
NB: Mandatory helmet legislation exists in Brisbane, where the survey was undertaken. Brisbane's bike share program *City Cycle* opens at 5am and closes at 10pm each day.

From Litman, T. (2015). Evaluating Public Transit Benefits and Costs: Best Practices Guidebook. Victoria Transport Policy Institute.



In their article, The Role of Attitudes, Transport Priorities, and Car use Habit for Travel Mode Use and Intentions to Use Public Transportation in an Urban Norwegian Public, Şimşekoğlu, Nordfjærn and Rundmo (2015) discuss the importance of marketability of public transportation as a way to increase support and usage. They argue that marketing campaigns against car use habit are necessary, because car habits are a powerful social construct. The authors explain, "One approach is to place greater emphasize on the positive aspects (e.g., safety, convenience) of public transportation and increase the desirability of public transportation by improving it according to the needs of mode users" (118). Thus, marketing and perception are an important aspect of increasing support and use of public transit.

Heinen (et al. 2015) describes findings from a study that examined the influence of the Cambridgeshire guided busway infrastructure on transportation mode share choice. Proximity to the busway was determined to be a major factor in mode share choice. The study found that the closer people lived to the busway, the more likely they will participate. The same goes for biking and walking, with closer proximity determining the choice for the shared transportation. It was found that association of use was stronger for cycling than for walking or bus use. Ultimately, the study found that in Cambridgeshire, UK, the addition of the new busway infrastructure did not deter walkers and bicyclists within urban areas, as there was no decrease in these mode shares. They also suggest that proximity to the busway may have greater potential to attract users outside of the city center and deter those from private car use for everyday mobility.

The flexibility of public transportation options needs to be improved in order to meet the needs of users (Şimşekoğlu, Nordfjærn and Rundmo, 2015). In addition, transit improvements tend to provide significantly more value to society than current evaluation models indicate (Litman, 2015). Thus, better evaluation models are necessary for influencing policy.

It is worth noting that in this review of literature there was a limited number of articles that addressed a comprehensive study of various modes of alternative shared transportation as we are investigating. Transportation sharing economies were not necessarily studied in conjunction with other modes of transport, rather they targeted and discussed how each sharing program is successful in combating single occupancy vehicle mode share.

This review of recent literature outlines current topics that are important and relevant to improving modes of sustainable transportation in cities with an emphasis on human powered mobility (walking and bicycling), sharing economy, and public transportation. Through this analysis, the team began determining definitions of the specific alternative transportation needs. Based on the studies reviewed, efforts, such as infrastructure improvements and policy changes, likely have positive impacts on increasing active and public transportation mode shares in cities. Multiple articles also indicated that these efforts do not necessarily influence change unless they are done in an integrated manner that complements each other and allows them to coexist. The greatest influences of these efforts are identified to be within urban areas, whereas the surrounding non-urban areas show great potential in shifting toward active and public transportation and possibly shared economies.

3.2.5 New York State Map

In determining alternative transportation requirements, the team developed a list of cities to assess in comparison with Syracuse as case studies. This list was derived first through a scope of specific cities in the United States that are motivated in an effort to improve sustainability in transportation. The team looked for cities in close distance proximity to Syracuse and decided on Albany, Buffalo, Rochester, and Yonkers. The four cities and Syracuse are part of the BuildSmart NY Program Five Cities Energy Plan, which examines how each city can reduce energy use in their municipalities. The four New York State cities are considered to be in line with Syracuse's efforts and are evaluated based on the number of projects and initiatives currently in progress or completed that seek to improve transportation alternatives as well as transportation sharing economies. This information has been collected and represented in the

form of a map that highlights and provides a profile of the mobility services each city offers and a quick view of ten projects and/or plans that are in progress or completed since the year 2000. The majority of the projects and plans occurred or began after 2010 with the exception of some outliers from the previous decade.

Among the five cities, Syracuse is the smallest in terms of metropolitan population with 662,577 (www.census.gov). Each other city has a metropolitan population over 1 million. Syracuse, with a relatively small downtown core area compared to Buffalo and Rochester, is similar in size to Albany and Yonkers. The city population of Syracuse is also smaller than the other cities with the exception of Albany. In terms of looking at the efforts in each of the five cities, Rochester is employing the largest number of total active and public transportation projects with 35. Syracuse follows with 24, Buffalo with 17, Albany with 14, and Yonkers with nine. As far as current mobility services offered, Albany currently leads the effort with 75 miles of bikeways (most publicly available), sharing economies, and a smart travel resource application called Capital Moves.

3.2.6 U.S. Nationwide Map

A deeper investigation of efforts nationwide was conducted and composed and compiled into a map graphic as well. This investigation led to a wider range of efforts for comparison with Syracuse. To find motivated cities across the nation, the team referred to the National Association of City Transportation Officials (NACTO) as the entity represents a nationwide effort to work on transportation issues. Particular cities have pledged membership, which led the team to cities targeting transportation issues as well as the potentially high number of projects, plans, and initiatives that could serve as good examples for Syracuse. Of the NACTO member cities and affiliate members, cities were chosen for comparison based on population density similar to Syracuse. Syracuse has a population density of 5,583 per square mile, which is higher than all of the cities chosen with the exception of Minneapolis. Cities with a city population higher than 150,000 and a metro population higher than 700,000 were selected for consideration in the study for their potential in providing exemplary successful projects for reference. Twelve NACTO related cities were chosen. These include Boulder, CO; Burlington, VT; Chattanooga, TN; Denver, CO; Detroit, MI; Fort Lauderdale, FL; Madison, WI; Minneapolis, MN; Pittsburgh, PA; Portland, OR; San Diego, CA; and San Jose, CA.

Referring to the map of the nationwide cities mobility services and applications, each city is highlighted in its geographic location on the United States map and provides an overview of current services offered as well as a quick look at ten projects currently in progress or recently completed. Syracuse's profile is also shown for comparison. Some cities to make note of are Boulder, Burlington, and Madison. These cities are similar to Syracuse in terms of city population and population density but appear to be much more successful in leading projects to improve active and public transportation. They also offer a wider range of sharing economies, which will be discussed further in this report.

By analyzing the efforts to produce alternative modes of transportation in each of these case study cities, the team can develop an understanding how to apply the successes to the Syracuse project. The team noted that cities with a comprehensive effort that included complimentary modes of transportation improvement achieved greater success than grand singular efforts. This idea is also backed by the literature review. With Syracuse's majority mode share of driving alone to work, it is possible that the gaps in transportation alternatives are a result of a lack of modes that are convenient, safe, and complimentary. From the list of active and public transportation projects the team was able to find for Syracuse, it appears there is a much larger effort to improve the ability to walk as opposed to bike—as well as improve the public transportation in the city. Of the 24 projects and initiatives in Syracuse, 18 are targeted to improve walking, four for bicycling and two for public transportation. A potential correlation between the breakdown of these improvements and the most recent mode share data is evident in the following Walking in Syracuse is the most common alternative mode of transportation to work. It is possible that the large number of improvements has an influence on the 10.4 mode share for walking. The mode share for biking and public transportation is 1.2 and eight (SMTC 2015). Biking in Syracuse looks to be an area for significant improvements, whereas, public transportation not so much. It is possible that with further enhancement and expansion of bicycle infrastructure and policy, bicycle ridership will increase as witnessed in some of the other cities.

As mentioned previously, efforts to reduce single occupancy in cars by making improvements for alternative transportation modes are more likely to have a greater impact if the provisions are convenient and safer than driving alone. The provisions should also be complimentary of each other to create an enhanced multi-modal network. The following elements of alternative modes of transportation will be explored in more detail in relation to each city and investigated to determine the usefulness for Syracuse:

- **Sidewalk improvements**—repairs and/or reconfiguration of sidewalks for increased pedestrian safety and mobility.
- **Pedestrian corridor**—designed pathway that promotes walking through improved sidewalks, tree shading, public seating, etc. The corridor places emphasis in creating pleasant travel conditions for pedestrian activity. This is typically an effort in areas with high-traffic volumes.
- **Enhanced bikeways**—this includes all types of dedicated bicycle thoroughfares. The improvements seek to increase the number of bikeways separated from vehicle traffic for safety.
- **Bicycle infrastructure improvements**—this includes ways of improving bicycle infrastructure other than increasing the number of bikeways, such as bicycle traffic signals, bike boxes, bike counters, intersection improvements, bike parking, etc.
- **Greenways**—pathways that promote walking and biking but intended more for recreational use.
- Active transportation plans and policies—efforts to improve walking and bicycling via methods of policy changes or prospective plans that advocate, develop, and implement strategies for safety, convenience, and increased mode share.
- **Bikesharing**—a network of bicycles available for paying or sponsored members by renting on a short-term basis. These systems require an operator for managing and maintenance. Typically, the sharing model for the network allows users to travel from point-to-point.
- **Ridesharing**—carpooling and vanpooling make up the majority of this element. The service is typically offered through an online service that works to create ride matches amongst a network of users with similar travel destinations and schedules.
- **Carsharing**—similar to bikesharing systems these networks offer a fleet of cars for shared use for paying and sponsored members. Again, an operator is required to manage and maintain the system. Sharing models typically include peer to peer sharing, docking point to return and also point-to-point sharing.
- **Ride hailing**—this includes traditional taxi hailing but even more so the growing demand of application-based services such as Uber and Lyft. The application-based services allow users to coordinate trips using the application on a mobile phone or electronic device for a fee.
- **Public transit infrastructure improvements**—includes improvements on stations, thoroughfares, intersections, etc.
- **Public transit plans and policies**—are efforts to increase flexibility and convenience of public transit as well as managing and improving ridership.
- **Bus rapid transit**—a bus-based transit method that specializes in faster operation and increased capacity. Usually, consists of bus dedicated lanes and other right-of-way privileges. Often more convenient to implement than rail-based transit.
- **Light rail**—rail-based transit that operates on the ground surface level and has right of way over other traffic modes.

Human-powered mobility needs across the cities varied based on funding resources, climate, and population. Certain cities were found to be more successful than others in either implementation of projects or development of plans. The number of projects, plans, and programs offer a variety of improvements and efforts; the team categorized the improvements and efforts into broader terms relating to their efficacy in improving human powered mobility. Based on this study, the team recommends the following for Syracuse:

- **Facility upgrades**—Engineering and infrastructure improvements to repair, beautify and improve safety for pedestrians and bicyclists.
- **New facilities**—Addition of facilities in either the pedestrian or bicycle network. This could be in the form of new lanes, paths, intersection additions, parking, etc.
- **Education resources**—Digital or physical resources for self-learning information on walking and biking.
- **Education programs**—Active programs provided and led by advocacy groups and organizations to help promote and encourage walking and biking.
- **Policy changes**—Improve policies to benefit pedestrians and bicyclists making them a priority as well as making travel to destinations more fun, safe, and convenient.
- **Outreach Marketing**—Increase awareness of walking and biking improvements around the city as well as the benefits of utilizing the network.
- **Funding Resources**—Seek funding from a variety of sources as well as redistribute funding toward human powered mobility services.
- **Action Planning**—Develop plans for maintaining the active transportation networks as viable options year-round.

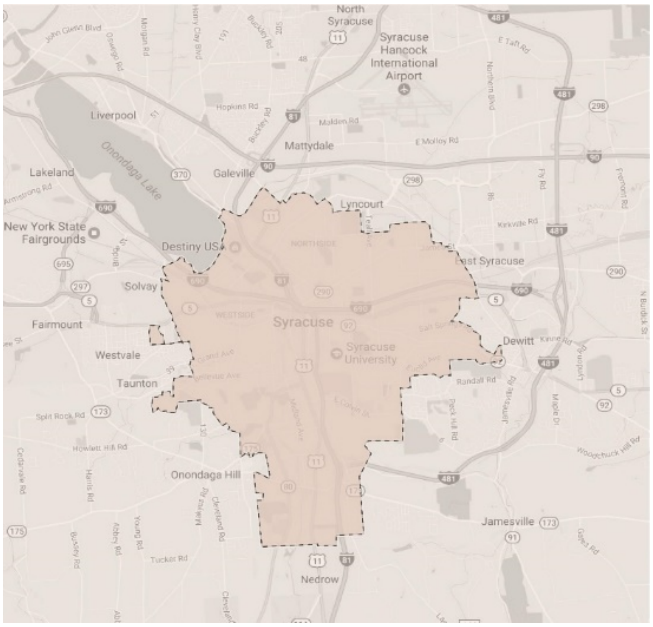
3.3 TASK 4 Conclusions—Preliminary Design of SyrIQ Multi-Modal Alternative Transportation Plan

Based on the studies carried out in Task 3, three scales of alternative transportation and planning were identified that focus on the City of Syracuse: beyond city, city, and downtown. The sub-designations were based on the intention of connecting Syracuse internally, while also creating efficient and productive links to the neighboring districts.

3.3.1 Beyond City Scale

The beyond city is the largest scale, which focuses on the border of Syracuse and goes beyond it to look at the immediate, neighboring districts. Some of the important cities around Syracuse include Solvay, Jamesville, Fairmount, Nedrow, Liverpool, and Dewitt.

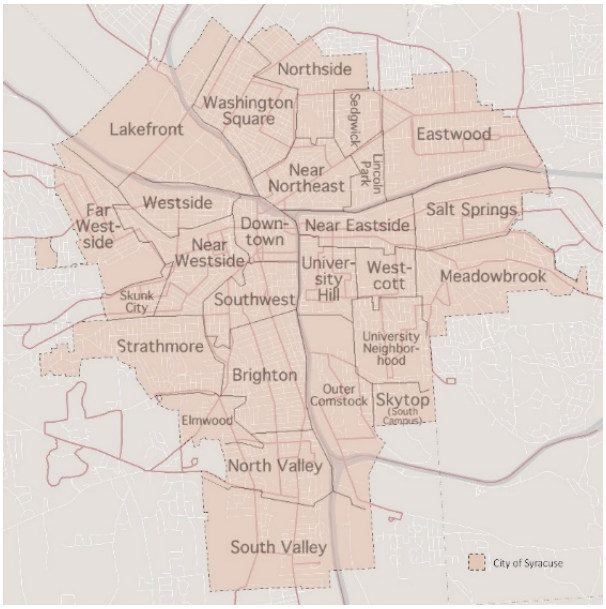
Figure 10. Syracuse Suburban Area



By aiming to form better links between Syracuse and its neighboring towns and villages, a "greater Syracuse area" can be envisioned that is rooted in Syracuse but maintains efficient connections to its surrounding localities. This creates a well-connected transportation network that will eventually be made into an attractive zone for people to inhabit and hence foster an employment market. Public transit will be the mode of transportation planned for and operated at this scale. The key issues to address are as follows:

- The Syracuse Hancock International Airport, currently difficult to access and is disconnected from city public transportation, should be brought into the network.
- A lack of options for public transportation in the Onondaga County. As mentioned in the resident public focus group, this cuts them off from the outer suburbs where there are job opportunities. Presently, CENTRO is the only available public transit within Syracuse.
- Housing projects have been built in communities where there are no retail or other job opportunities, and there is little public transportation, as also discussed in focus groups. This creates a lower economic value for these areas and burdens commuters.

Figure 11. Syracuse City Scale



3.3.2 City Scale

This scale of study emphasizes the interconnections within the city itself and proposes the strengthening of ties between its districts. Prominent business districts include: downtown, Eastwood, Little Italy (part of the Near Northeast), University Hill, and Westcott. The goal is not only to densify the business districts and popular zones to form hubs of potential growth, but also to form links to the sparsely-connected areas of the city. The primary form of transit to be implemented is sharing economy. The main areas of concern are as follows:

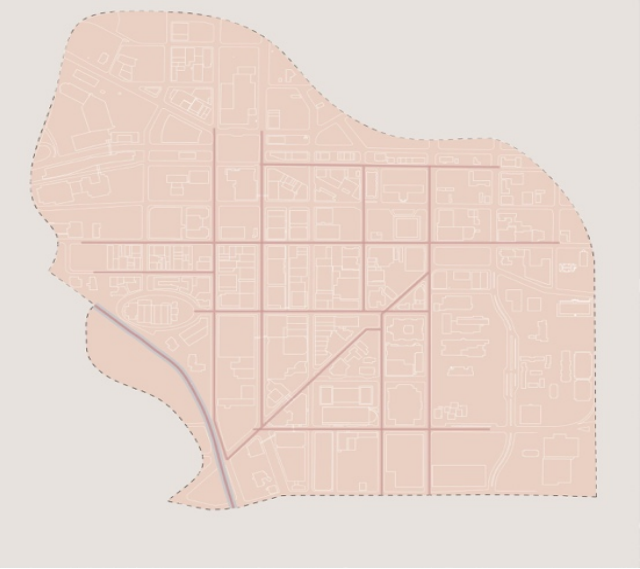
- Currently, the city is broken down into distinct neighborhoods based on economic status. With the city scale plan, these borders would be blurred and eventually, dissolved—ensuring there is a stable transportation network across the city.
- Public transportation is concentrated in more affluent areas of the city where most people already own cars.
- CENTRO is the only mode of public transportation in the city, which leads to challenges due to fewer bus routes, frequencies, and connections than necessary.

3.3.3 Downtown Scale

The final scale of planning is based in the downtown district in Syracuse. The objective is to develop the area into a place that not only attracts more students and visitors, but also encourages people to relocate from their suburban neighborhoods to increase density and further promote walkability. Human-powered mobility is the primary mode of transportation that will be applied in this area. Key issues to be overseen at this scale include the following:

- The district is not fully walkable and bikeable, even though it is the most pedestrian and bike-friendly neighborhood in the city.
- Street design does not promote safety and comfort and the streets are underutilized.
- The present street network does not offer easy access to the downtown area.

Figure 12. Syracuse Downtown Scale



3.3.4 Map of Priority Network

The city can be successfully transformed by focusing on safe and high-quality design for two north and south streets and two east and west streets that connect zones of interest that will be detailed in section 3.3.11.1. To proceed using this method would be cheaper, faster, and more effective than designing every street in the city. Once the design for the north/south and east/west primary connectors are put into action, focus can be placed on developing secondary connectors for future design.

Efforts should be made to find underutilized roads for re-striping. It is more efficient to focus on high-quality design efforts on roads that are already equipped with the necessary resources of space. Streets that have too many lanes for traffic or have lanes that are too wide can be reconfigured to decrease the amount and size of car lanes. Not only does this encourage slower driving and safer walkable areas, but it also allows for the extension of sidewalks and the addition of bike lanes and parking.

3.3.5 Identifying Syracuse's Priority Network

3.3.5.1 Sub-zoning of the Downtown Area

Through an analysis of land use, revitalization projects, and identifying points of interest, downtown Syracuse can be subdivided into four zones of interest that work together in a comprehensive network that provides for walking and biking. These zones include the following:

- Armory Square—Dense mixed use, residential and commercial neighborhood.
- The Civic Strip—Belt of political, cultural, and recreational institutions as well as historical landmarks.
- The Hotel Syracuse Area—Historical redevelopment that connects Armory Square to The Civic Strip.
- Hanover Square and Clinton Square—Smaller-scale version of Armory Square as mixed-use, dense, recreational, and commercial neighborhood.

3.3.5.2 Primary Street Connectors

Once the compelling areas of Syracuse have been identified, feasible and popular streets are chosen as the connectors in the priority network. Five primary streets are suggested for high-quality walking and biking designs in the initial stages of redevelopment based on their potential and location. The main streets include the following:

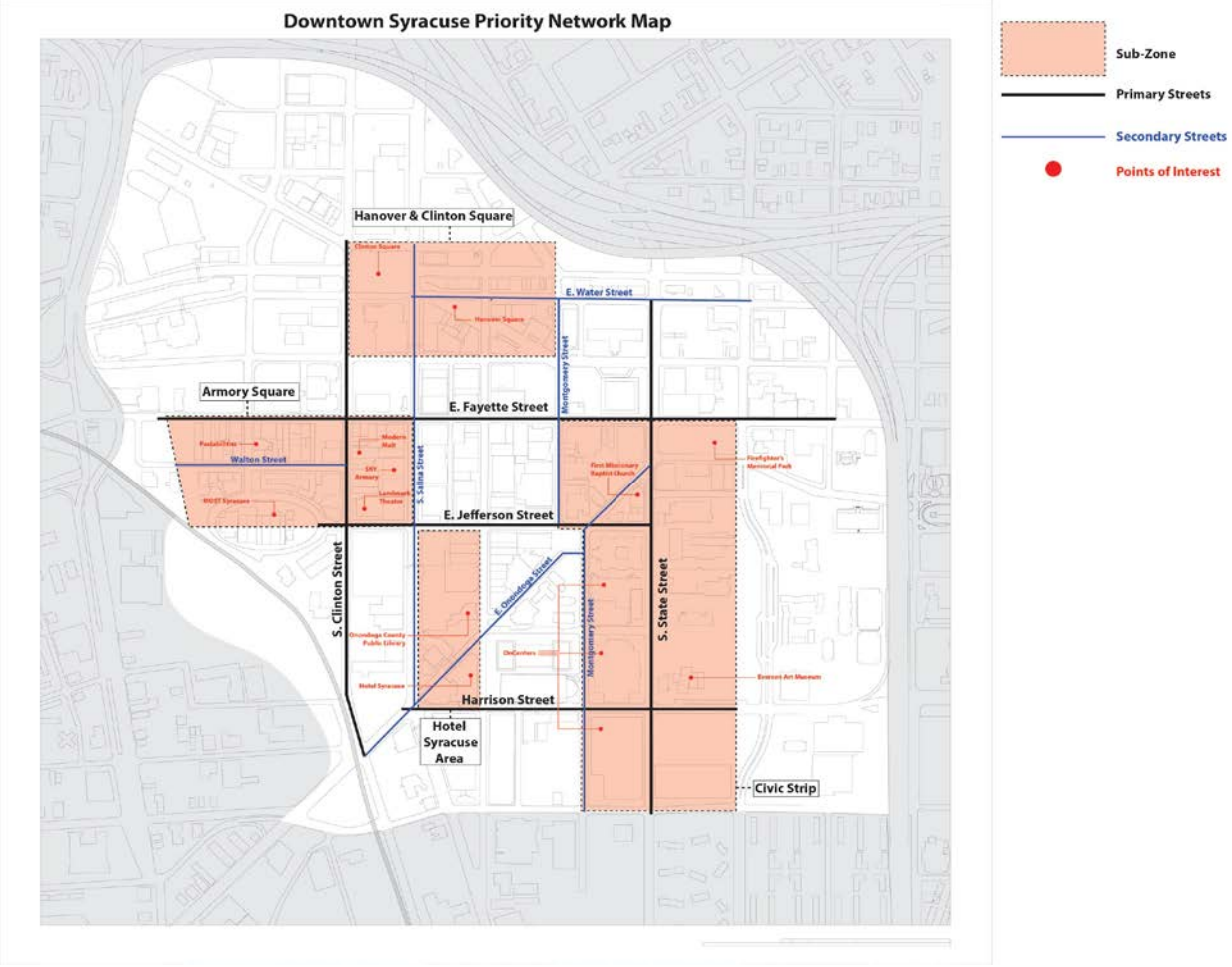
- South Clinton Street (N/S)
- South State Street (N/S)
- East Fayette Street (E/W)
- East Jefferson Street (E/W)
- Harrison Street (E/W)

3.3.5.3 Secondary Street Connectors

After the design, implementation, and testing of the primary streets have been accomplished, the next step for street design includes the development on the following secondary streets:

- South Salina Street (N/S)
- Montgomery Street (N/S)
- East Water Street (E/W)
- Walton Street (E/W)
- East Onondaga Street (NE/SW)

Figure 13. Downtown Syracuse Priority Network Map



3.3.6 Applied Case Study Design Strategies

The following recommendations focus on the re-striping of these streets and their subsequent zones into a multistage process for redevelopment to enhance the ability to walk and bike.

3.3.6.1 Civic Strip

Figure 14. Outline of Civic Strip

The "Syracuse Connective Corridor Civic Engagement Initiative" has developed a "connector route" that improves street design for walking and biking to better connect University Hill and downtown Syracuse. Construction of this two-mile route has been completed along University Avenue, East Genesee Street, and West Fayette Street. The next phase of the process is to design a civic strip that runs through the city's cultural and civic institutions. The current plan for the civic strip—developed by the Connective Corridor—runs along South State Street and Montgomery Street, as well as East Jefferson Street, presumably connecting the civic area of downtown with Armory Square. This proposal suggests beginning the first stage of development by focusing on the primary street of South State street (a current NYS highway) for the following reasons:

- On both sides of South State street, there are important cultural institutions, art museums, entertainment facilities, and government buildings that are vital to Syracuse's operations. Notable points of interest along the street include all of the OnCenter buildings, Everson Art Museum, and Syracuse City Hall. In addition to these points of interest, there are government buildings such as the Onondaga County Justice Center, City Court, and the State Office Building that make this a civic belt.
- South State Street is a five-lane street highway. By standards required for peak vehicular traffic for a mid-sized city, it has more lanes than needed. Therefore, the excess space is available for curb-to-curb for redevelopment.

The redesign of South State Street can occur in stages, starting with defining it as an arts, cultural, and heritage district and turning it into a public art corridor with visual installations and interactive spaces designed by students and local artists. The following process is recommended for the redevelopment of the street:

1. An architectural lighting system designed to illuminate the city's iconic architecture along the strip, as well as augmenting street activity by increasing the safety of the sidewalk.
2. Historic wayfinding system of signage along the strip to encourage walkability, similar to the Walk [San Jose] signage system under the Walk [Your City] initiative that has proven to excite the city's inhabitants and visitors.
3. Re-striping of the street to include one lane per way, both 10 feet wide, to slow down traffic. This creates more room for the addition of bike lanes on both sides as well as a buffer such as a concrete curb in between traffic and bikers. Another alternative is to separate bikers from cars with a parking lane, a cheaper and quicker way than building new infrastructural buffers.
4. As sidewalks are already wide at 30 inches and 50 inches; tree plantings and street furnishings should be increased between pedestrians and the roads to provide a safer walking and biking experience. Redevelopment of the sidewalk can also include the addition of outdoor bistro seating areas and sidewalk cafes to liven up the streetscape. Later stages of redevelopment should also focus on historic preservation of important buildings along the strip through facade improvements.
5. Redesigning of public parks and spaces with landscape. One notable park along the civic strip is the Firefighter's Memorial Park which could provide pleasant green space within an urban environment.

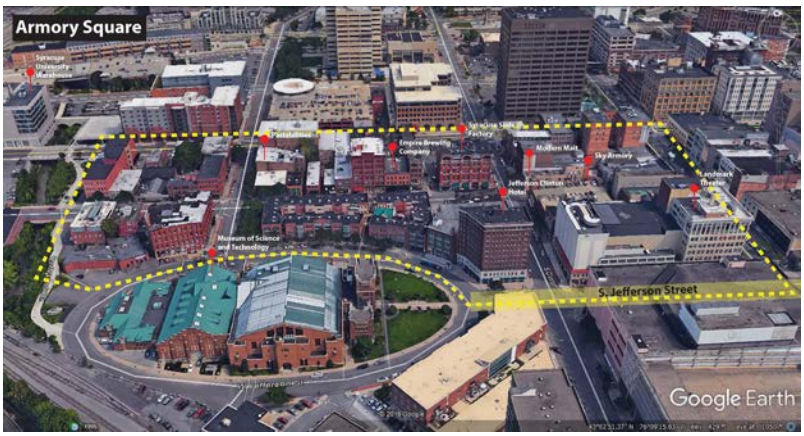
In addition, the Connective Corridor's civic strip plan proposes an urban video project of an IMAX-scale outdoor video projection to further develop the area as a cultural and artistic district.

While South State Street is being redeveloped, another primary street of focus within this area should be on East Jefferson Street, a one-way street, as this is the main connector between the civic strip and Armory Square. The main objective should be to convert the street to a two-way road as a decision to increase safety and decrease confusion.

Figure 15. Civic Strip (South State Street)

3.3.6.2 Armory Square

Figure 16. Outline of Armory Square



Armory Square is one of the most successful nodes of activity in the downtown area. Its mixed-use, commercial and residential programs as well as dense, short city blocks makes it the most favorable area for the ability to walk and bike. The main streets running through Armory Square are West Jefferson, Walton, West Fayette, South Clinto, and South Salina. The primary streets of re-striping should be focused on West Jefferson Street and South Clinton Street, as these run along the edges of Armory Square and connect it with the other three zones of interest. Design recommendations for South Clinton include the following:

- Convert it from a one-way street into a *two-way street*, making it less destructive and confusing, and easier for people to get to Armory Square.
- *Reduce the number of lanes*, as S. Clinton Street does not need more than two lanes with a peak hour traffic count of only about 8,000 cars per day. This allows more room for bike lanes and buffering where space permits.
- *Bike rack stations* should be installed to accommodate bikers who want to come to the area and walk around.
- Make *sidewalk improvements* such as adding public seating, lighting, greenways, and infrastructural systems like stormwater management, and street plantings.
- Improved *wayfinding signage* system, similar to the one previously mentioned along the Civic Strip, that help show that travel distances are not as far as perceived.

Figure 17. Armory Square (S. Clinton Street)

Secondary streets such as Walton, South Franklin, and the portion of West Jefferson near the old Armory will benefit from removing cars from the road all together. Alternatively, the street's design should be refocused to prioritize the pedestrian and biker and make the driver the secondary. One way to do this would be to adapt the almost-curbless strategy of the streets of Denver, CO, specifically the one along Wynkoop Street, to dramatically slow down vehicular traffic. In a bold move, they put the sidewalk on the same plane as the street and paved the street to match the ones of the sidewalk, creating one continuous sidewalk from building to building. This would not only make the street safer by creating a slow zone but would also create a livelier and visually appealing streetscape.

Figure 18. 16th Street Mall, Denver CO

Figure 19. Clinton and Hanover Squares

Similar to Armory Square but on a smaller scale, Hanover Square is characterized by short, dense city blocks and mixed-use program with businesses on the ground level and residential on first level. Since Hanover Square connects the civic strip to the Clinton Square, the focus should be on developing the portion of East Genesee Street that runs through Hanover Square. Since the Connective Corridor initiative has already built bike lanes along East Genesee Street closer to the University Hill area and onto East Fayette Street, bike lanes should be placed down Montgomery Street, continuing the bike path from East Fayette Street to East Genesee Street that runs through Hanover Square, bringing people through both Clinton and Hanover Squares.

East Genesee Street's current design within Hanover Square is similar to the almost-curbless street design in Denver, CO, and would be a good precedent to look at for the design of secondary streets within Armory Square. A design consideration for East Genesee Street could be to remove car circulation through that part of the street and add bike lanes, fully prioritizing the pedestrian and biker. This would be feasible as Clinton Square acts as a large open plaza, and often has celebratory events like farmers' markets and festivals, and even opens up an outdoor ice-skating rink in the winter. These events encourage walking, and hence, walkable design from Clinton Square through Hanover Square would allow for a safe, easy, and pleasant promenade all the way down to the civic strip.

Figure 20. Hanover Square

Figure 21. Hotel Syracuse Area

With the renovation of the historical Hotel Syracuse completed, now called Marriott Syracuse Downtown, the area aims to revitalize the historical prominence it once held in the downtown network. This redevelopment is complemented by the nearby Onondaga County's public library, which has expanded onto the first floor of the building to create a street presence within the urban environment. In addition, the former Sibley's building along South Warren Street and within the South Salina Street Downtown Historic District was bought by developers who plan to contribute to the revitalization of this area into apartments, office, and retail space, and its construction has already begun. Its proximity to the OnCenter as well as the Onondaga County Convention Center is also opportune, as it acts as the official headquarters hotel for the convention center.

As the redevelopment of this area is underway, it is creating an important node within Syracuse's priority network for walking and biking, as it connects Armory Square and the civic strip. Therefore, the primary street focus within this zone should be Harrison Street, connecting the hotel with the Nicholas J. Pirro Convention Center, one of the OnCenter facilities. The following design recommendations for Harrison street are as follows:

- Convert it from a one-way street to a two-way street. It currently is a one way with three lanes, an unnecessary amount for the density of the area.
- Decrease all lane sizes to 10 feet, as they are currently wider than necessary, at 12- and 14-feet wide. This will result in slower driving and create room for buffered bike lanes.
- Remove the parking spaces in front of the Syracuse Tech garden, as it is unnecessary and underutilized. The space could be better used to extend the sidewalk and improve the streetscape through tree plantings, street furniture, and lighting. In addition, the area replacing the parking spaces and the extended sidewalk could act as a covered stoa, or shed, from sidewalk activity such as temporary street vendors to further liven up the streetscape.

Figure 22. Hotel Syracuse Area (Harrison Street)

While Harrison is being redeveloped, the second stage of development should focus on the design of South Salina and South Warren streets, as they run along the entrances of the library, hotel, and Sibley building. Emphasis should first be placed on South Salina, as it is a connector of this area to Armory Square. Since South Salina represents one of the most typical conditions of streets downtown and already includes pedestrian friendly sidewalks with street furniture, amenities, and plantings, the main design recommendation would be to add bike infrastructure. Since the lanes are currently oversized at 20 feet wide with an additional 8 feet of parking, it is recommended that the width of street lanes be reduced and parking is reconfigured to be placed as a buffer zone between cars and newly added bike lanes.

The city-scale plan addresses the mobility issues across Syracuse. Two plans are developed—the short-term plan and the long-term plan—that propose solutions for immediate implementations and those that are to take place across a longer time frame. These plans offer design proposals encompassing bike sharing and carsharing economies as well as e-biking. The main concept for the planning and organization of the city follows the idea of centralized locations based around institutions.

3.3.7 Anchor Points: The Short-Term Plan

For the short-term plan, based on the connectivity requirements in Syracuse and its issue of suburban sprawl, the main aim was to make "anchor points" in Syracuse more accessible to everyone.

The success of car and bike sharing within a mid-sized city can be directly linked to the focus of the lineage of major institutions. A walkable city requires that there be a direct connection between the areas that people want to access. Based on this idea, the following anchor points identified in Syracuse are the following:

- Syracuse University
- Le Moyne College
- Armory Square
- Syracuse Innovation District
- Syracuse Hancock International Airport
- SUNY ESF
- Destiny USA/Central New York Regional Market
- William F. Walsh Regional Transportation Center
- Syracuse Zoo

3.3.8 Design Concept

Within the scope of the short-term plan, the structure of the city would not be altered. However, the way that people and vehicles operate with the city would differ. Bike-sharing systems would focus in these areas to facilitate services to those that prioritizes bicycles instead of vehicles. To get from one zone to another, the options would be to use a (1) bike in a bike-sharing system, (2) public transit when available, or (3) car in a car-sharing system, specifically for transport between the zones and not within the zones themselves.

3.3.9 Bike Sharing

Based on the Bike Share Planning Guide by The Institute for Transportation and Development Policy, the following are what cause the most successful systems.

1. A dense network of stations across the coverage area, with an average spacing of 300 meters (approximately 984 feet) between stations.
2. Comfortable, commuter-style bicycles with specially designed parts and sizes that discourage theft and resale.
3. A fully automated locking system that allows users to check bicycles easily in or out of bike-share stations.
4. Wireless tracking system, such as Radio-Frequency Identification Devices (RFIDs), that locates where a bicycle is picked up and returned and identifies the user.
5. Real-time monitoring of station occupancy rates through wireless communications, such as general packet radio service (GPRS).
6. Real-time user information through various platforms, including the web, mobile phones and/or on-site terminals.
7. Pricing structures that incentivize short trips helping to maximize the number of trips per bicycle per day.

Almost all of the above suggestions can be feasibly applied to Syracuse. However, the suggestions do not consider factors such as weather conditioning and the change in topographical surfaces across the city.

In order to make a bike-share system that is well frequented and efficient, the Institute for Transportation and Development Policy has also implemented parameters following planning and design. Under these parameters, the minimum system coverage area of 10 km^2 is just over the total square footage of Syracuse's city limits. Based on this information alone, it is evident that the system is not designed for city of a middle-sized range. Considering this framework, the system next recommends placing 10 to 16 docking stations every km^2. This means that Syracuse would have between 100 and 160 bike stations and based on the population of the city at 144,000, would require 10 to 30 bikes for every 1,000 people. Under these performance metrics, there are estimated four to eight daily uses per bike and an average of one daily trip per 20 to 40 residents per day.

3.3.10 Carsharing

Carsharing within Syracuse is another viable option. Carsharing began in cities across the United States as a way for people to make use of the benefits of a car without the determinants. Originally "fueled by environmental concerns and increasing worries about the cost of gas" carsharing has become normalized and is a feature of many American cities. More convenient than simply renting a car from companies such

as Enterprise or Hertz, carsharing companies allow you to rent and pay by the hour with locations that are convenient for both pickup and drop-off. Often designed for short-term use, these cars allow people to perform larger tasks in their daily lives without having to be dependent on a car.

3.3.11 Density: The Long-Term Plan

The long-term plan for Syracuse proposes creating CENTRO bus routes and infilling carsharing and bike sharing systems in areas that are visibly devoid of public-transit options and are poorly connected. These areas are diagrammed in maps in Figures 24–27 to demonstrate the zones that have low densities of transportation methods. Interestingly, these zones also coincide with areas deemed as "below-average neighborhoods" while well-connected areas reflect as "good neighborhoods."

The majority of movement happens in the center of the city, primarily between the Syracuse University campus network and the Armory Square area. Other areas include Destiny USA and the Onondaga Community College.

Associations such as NACTO and the Institute for Transportation and Development Policy have design guides which can and have been applied to a large-scale city. However, these same strategies are inapplicable to cities of the size and type of Syracuse. NACTO says in its guide that the main aim "is to provide cities with state-of-the-practice solutions that can help create complete streets that are safe and enjoyable for bicyclists." The planning guide's studies on feasibility suggest that Syracuse does not meet the size requirement of having an area of 10 km^2 for a bike-sharing system. It also recommends considering the landscape through an analysis of risk and barriers, as the number and location of hills in the City of Syracuse makes implementing bike-sharing systems a challenge.

The logic behind this recommended service for a bike-sharing system is that, for short distance trips, people will use bikes to get around and for trips outside of the immediate zone, people will take the bus until they reach their desired zone, and then have the option to bike to the more specific location. In this way, the focus shifts from those who are operating an individual car to those who are riding a bike. By shifting the focus from cars to bikes, bikes can begin to be the most desirable method of transportation.

Figure 23. CENTRO Map with Walking Radius (Quarter Mile) Around a Bus Stop

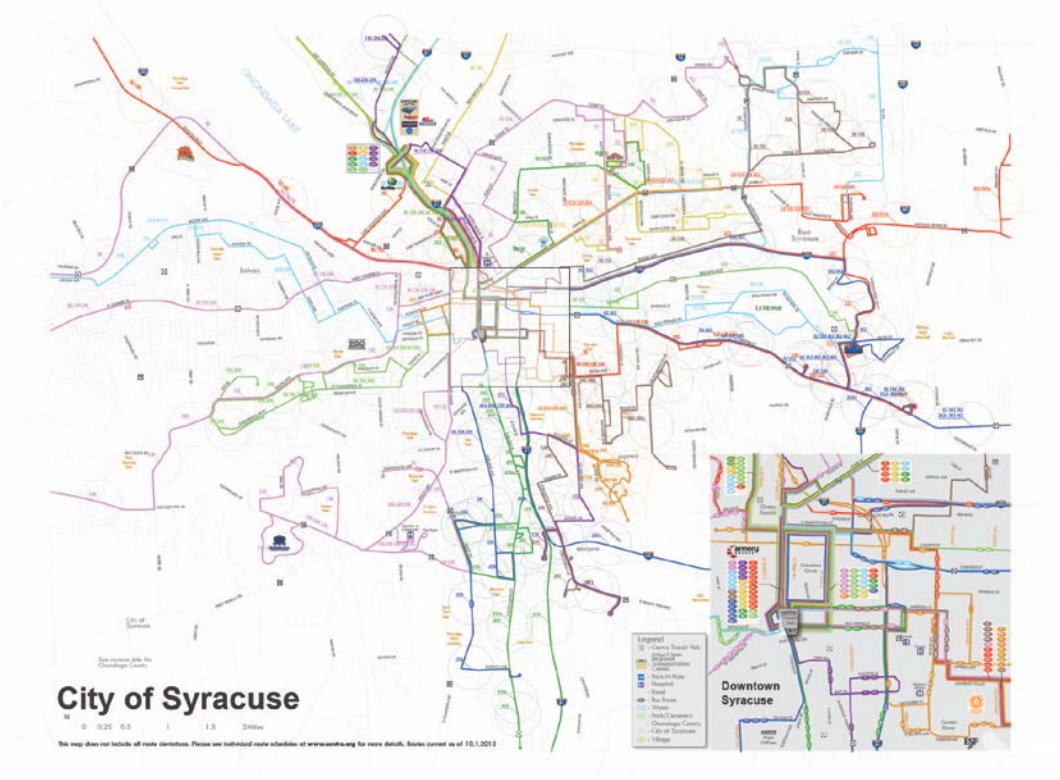


Figure 24. Areas Devoid of CENTRO Bus Service

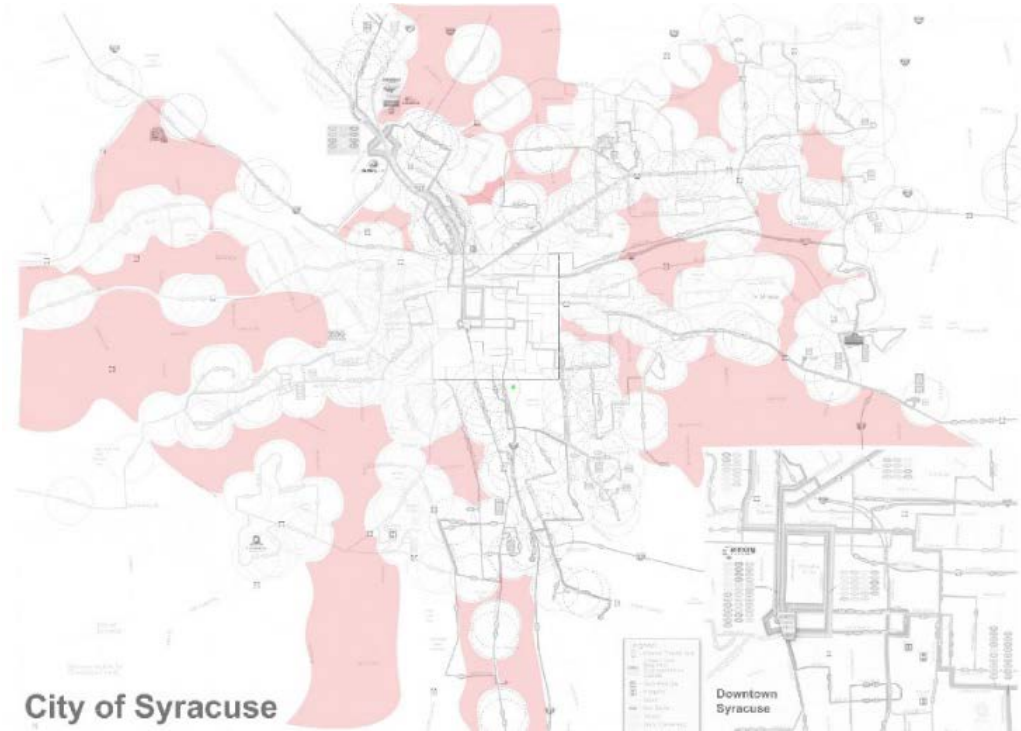


Figure 25. Syracuse Districts Livability Scores

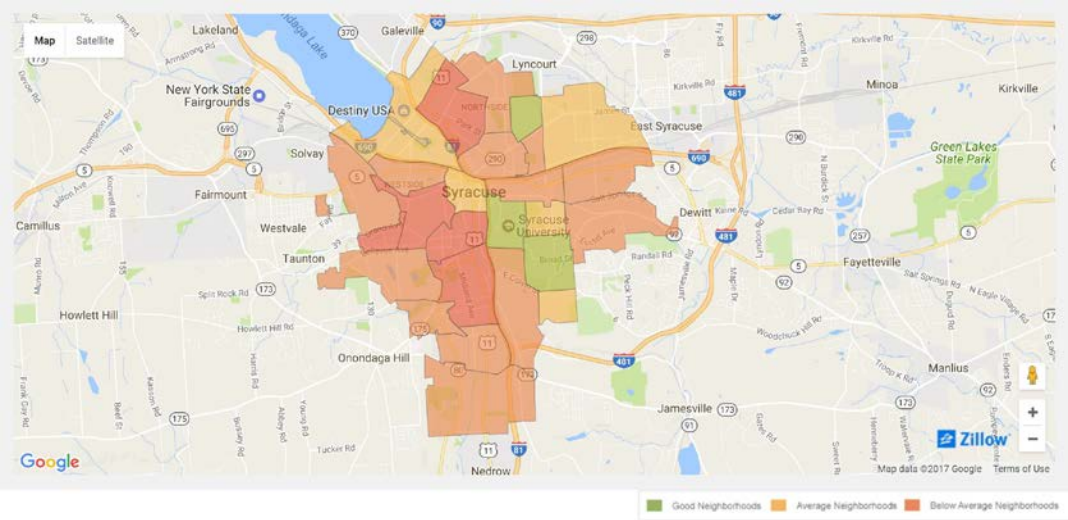
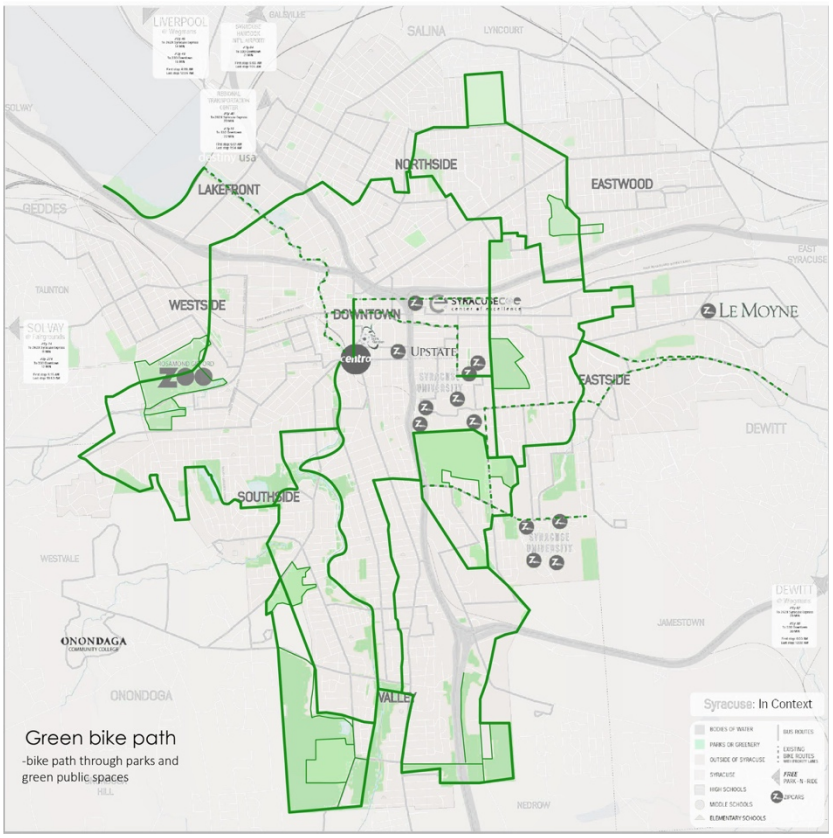
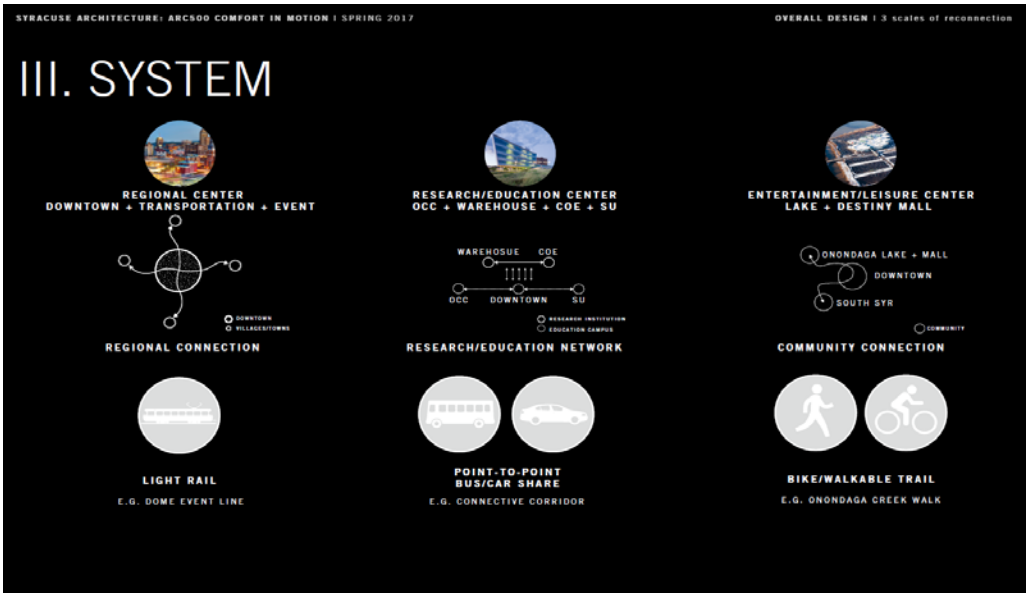


Figure 26. Green Bike-Leisurely Network of Lanes through Public Parks and Green Spaces



Professor Tarek Rakha conducted a professional elective seminar with Syracuse University School of Architecture students titled *Comfort in Motion* in which the students redesigned the transportation systems in Syracuse. The work in Figure 28 was produced by the students in a study of the regional transportation system in Syracuse. The students proposed three forms of transportation for three nodes of connection throughout the city and region: a regional light rail system, an institutional point-to-point bus and carshare system, and a more centralized bike and walk trail for downtown and surrounding areas. These three systems work independently to connect particular parts of the city or the county and combined, create a comprehensive transportation network for the major nodes of Syracuse and its surrounding areas.

Figure 27. Proposed Light Rail System



The proposed light rail system for the city of Syracuse and the surrounding towns or villages in Onondaga County is mapped out in Figure 28. The stops are centered within hubs of business or living and placed with consideration to the beginning or final leg of travel (e.g., how residents would get to the stations). The light rail routes follow existing transportation infrastructure in the region, which is mainly for cars, so as to work within the existing system of design. The light rail system would be a very expensive and long-term plan for the region that would alleviate the traffic problems and give people a sustainable, easy travel option for around Onondaga County and especially for traveling to the city and downtown, which it radiates out from.

3.4 TASK 5 Conclusions—Projected Impacts and Financial Feasibility Assessment

Benefits associated with increased bicycling and walking activity are numerous and well-documented. Some of these benefits such as improved public health, strengthened local economies, and enhanced quality of life are societal in nature. Others, such as fuel savings and emissions reductions resulting from less automobile travel, can be categorized as "green energy" benefits. This section describes a quantification of potential green energy benefits in Syracuse associated with increased bicycle facility provision.

Estimates were generated for trips between origins and destinations for the study area. Greenhous gas (GHG) emissions were computed based on the calculator developed for Florida Department of Transportation (DOT) and described in the Conserve by Bicycle and Walking, Phase II Report by the Florida Department of Transportation. The main purpose of this calculator is to estimate trips, showing benefits specifically related to an increase in biking and walking. It is focused on transportation elements and uses Level of Service (LOS) as a basis. Attached to this document is an overview of the benefits calculator taken directly from the aforementioned report and Appendix B describes the details of the methodology.

The bicycle facility recommendations included in this plan—including opportunities to create new paved shoulders or bike lanes through road diets, roadway restriping, and adding paved shoulders—illustrate that it is feasible to increase bicycle facility provision on the study network to 100%.

The following list identifies assumptions used with the Green Benefits Calculator for the Syracuse FAST project, which clearly demonstrate significant potential for green energy benefits associated with increased bicycle commuting, resulting from better accommodation of bicycle travel in Syracuse. Trip mode share figures were estimated using the calculator provided in the Conserve by Bicycle Program Study published by Sprinkle Consulting.

- Greenhouse gas emissions for personal car trips and transit trips were calculated using an average car fuel economy of 20 miles per gallon (Conserve by Bicycle Program Study).
- Average bus fuel economy of 7.3 miles per gallon (Bureau of Transportation Statistics).
- Emission factors of 19.6 pounds CO_2 per gallon gasoline combusted, and 22.4 pounds CO_2 per gallon diesel combusted (EIA).
- An average occupancy of 1.43 parts per million by volume and 30 parts per billion (Conserve by Bicycle Program Study).
- 2014 U.S. Census data and GIS software were used to determine the population and employment density as well as the weighted population within 10 miles and 0.75 miles radii from the center point of the study focus, which were reported as 89,047 and 48,536 persons, respectively. The central Census tract containing the center point of the study area was treated as a zero-distance point with non-weighted population.
- An average trip length of six miles was used (Conserve by Bicycle Program Study).
- Annual Average Daily Traffic (AADT) data from the NYS Department of Transportation for each roadway were used.

Increased bicycling and walking activity have various benefits. These include health, economic, and quality of life enhancements. Others "Green Benefits" comprise fuel savings and consequent emissions reductions due to reduced vehicular travel. This section describes quantifying potential green benefits in Syracuse associated with increased bicycle facilities. Study area trip estimates were generated between origins and destinations. Greenhouse gas (GHG) emissions were computed based on the calculator developed for Florida Department of Transportation (DOT) and described in the Conserve by Bicycle and Walking, Phase II Report. The main purpose of this calculator is to estimate trips, showing benefits specifically related to an increase in biking and walking. It is focused on transportation elements and uses Bicycle LOS (BLOS) and Pedestrian LOS (PLOS) as a basis, as well as demographics (distance-weighted population and population and employment density numbers). The demographic numbers were calculated using data from the U.S. Census Bureau's 2014 American Community Survey block group dataset for the study area. The two distance-weighted population numbers called for by the Sprinkle Benefits Calculator were those within a 0.75-mile radius and a 10-mile radius of the center of the study area. Based on the documentation for this tool, the populations of each census block group within

the desired radii were divided by the square of the distance from the centroid of each respective block group area to the center point of the study. The central census tract containing the center point of the study area was treated as a zero-distance point with non-weighted population. The 0.75-mile and 10-mile radii contained 48,536 and 89,047 persons, respectively. The population and employment numbers from the block groups inside the study area were divided by their areas to find the employment and population density of each block group, which were then averaged to find the average population and employment density within the study area. These were found to be 6116 persons/square mile and 263,176 jobs/square mile, respectively.

The streets within the Syracuse study area were analyzed for all of the LOS determining factors and input into the LOS calculation section of the Benefits Calculator spreadsheet. The results of the LOS analysis are as follows:

Table 3. Level of Service (LOS) Analysis

Street Name	Bicycle Level of Service				Pedestrian Level of Service			
	Existing		Proposed		Existing		Proposed	
E. Water Street	2.09	B	0.2	A	1.15	A	0.95	A
E. Washington Street	4.11	D	0.2	A	1.56	B	0.81	A
W. Fayette Street	4.15	D	0.2	A	1.77	B	1.33	A
E. Fayette Street	0.54	A	0.2	A	1.76	B	1.44	A
E. Jefferson Street	2.77	C	0.2	A	1.51	B	0.86	A
Madison Street	3.02	C	0.2	A	1.25	A	0.87	A
Harrison Street	3.67	D	1.2	A	1.87	B	1.49	A
E. Adams Street	3.69	D	0.2	A	2.36	B	1.48	A
S. Salina Street	1.64	B	0.2	A	2.08	B	1.42	A
S. Clinton Street	4.09	D	0.2	A	1.33	A	0.56	A
S. Warren Street	2.96	C	0.2	A	1.38	A	0.98	A
Montgomery Street	2.22	B	0.98	A	1.59	B	1.44	A
S. State Street	3.62	D	0.2	A	0.48	A	0.51	A
Market Street	2.81	C	0.55	A	1.66	B	1.35	A
Bank Alley	3.55	D	0.2	A	2.39	B	1.7	B
Harrison Place	1.3	A	0.2	A	1.77	B	0.93	A
E. Onondaga Street	2.08	B	0.2	A	2.1	B	1.53	B
Overall	2.84	C	0.33	A	1.65	B	1.16	A

Benefits were collected to include the proposed alternative transportation methods for trips generated for the study area. The overall benefits focus on health, energy efficiency, pollution, real estate value, resilience and social equity. Annual data for both scenarios, focusing on fuel savings, CO_2 emissions reduction, and health costs savings, is summarized in the table below.

Table 4. Estimated Benefits for Alternative Transportation Scenarios

[1]- US Energy Information Administration. https://www.eia.gov/tools/faqs/faq.php?id=307&t=11 [2]- US Bureau of Transportation Statistics. https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/ publications/national_transportation_statistics/html/table_04_15.html

	Fuel Savings (gal)	Fuel Savings ($)	CO_2 Emissions reduction (tons)	Health Care Benefit
Scenario 1	21,500	$53,800	216	$58,400
Scenario 2	28,000	$70,100	251	$9,600

The project report highlights marketing approaches for alternative transportation from NACTO's cities. Each of these cities have a pedestrian, bike, and transit plan for the city and various efforts to implement those plans. Additionally, these cities have created indicatives to market and promote alternative transportation to its residents. Firstly, the document discusses the Alternative Transportation Promotion efforts of the NACTO cities and how they have branded their alternative transportation programs for the specific cities. Then the document is broken down into different marketing efforts, including Online Programs, Community Input, Wayfinding, Graphics Effort, Partnerships, Competitions, Artists Relationships, and Grass Roots Efforts. These categories cover the different marketing efforts that the cities created and how those efforts interacted with the inhabitants and workers of each city. The *Online Programs* cover the different websites that cities have created to help people plan their commutes and understand the transit systems through interaction with these websites. Certain cities include different initiatives with these websites, such as incentives for logging alternative transportation trips. The *Community Input* showcases efforts in the City of Pittsburgh using an online "Collaborative Map" in which users could add their ideas and insights geographically for their neighborhoods. The *Wayfinding* section shows how cities can put up signs around the city to promote alternative transportation movements to different important nodes within downtown. The *Graphics Effort* discusses a branding initiative by a city to make the public transit more fun and identifiable for its residents. The *Partnerships* section considers different city partnerships with either businesses/employers or schools to promote alternative transportation within those specific programs. The *Competitions* section looks at some non-NACTO cities and how to incentivize alternative transportation commuting through different scales of competition. The *Artists Relationships* discusses city projects that incorporate local artists to assist and promote alternative transportation, often through the conversion of empty lots. The *Grass Roots Efforts* covers a case study. Specifically, how the city of Burlington has supported and promoted grassroot projects from its residents by creating a guide for people to follow.

Table 5 outlines the background information for the NACTO cities, with the top statistics highlighted in yellow, and which marketing methods the document discusses from each city's alternative transportation programs.

Table 5. NACTO Cities' Alternative Transportation Marketing

NACTO Cities	Population Density	Total Pedestrian Improvement Projects	Number of Education/ Training Resources	Walking Mode Share	Walk Score	Online Programs	Community Input	Wayfinding	Graphics Effort	Partnerships	Artists Relationships	Grass Roots Efforts
Boulder, CO	3,947	25	n/a	10.1%	54							
Burlington, VT	4,121	17	3	20%	54							
Chattanooga, TN	1,222	13	1	2.7%	29							
Denver, CO	4,044	25	1	4.1%	60							
Detroit, MI	5,142	6	n/a	1.4%	55							
Ft. Lauderdale, FL	4,761	16	1	1.7%	58							
Madison, WI	3,037	21	2	9.6%	48							
Minneapolis, MN	7,485	24	1	7.8%	68							
Pittsburgh, PA	5,540	7	2	10.9%	61							
Portland, OR	4,375	28	3	5.4%	64							
San Diego, CA	4,003	36	2	1.8%	50							
San Jose, CA	5,600	5	1	1.8%	50							

4 Statement on Implementation

The outcome of a professional elective seminar taught by Prof. Tarek Rakha at Syracuse University School of Architecture entitled *Comfort in Motion* developed designs for City of Syracuse transportation systems. The work in Figure 28 was produced by the students in a study of the regional transportation system in Syracuse and the potential of short-term and long-term design interventions. As stated in the previous subtask, some design measures are recognized as longer term projects, especially the regional light rail system, due to their infrastructural needs and timely and costly construction. However, other designs such as the bus and carsharing system can be introduced more promptly within the existing street conditions and infrastructure. The primary focus of this study was Interstate 81, which is currently under review by New York State Department of Transportation to either remove the downtown viaduct and create a community grid or to rebuild it up to current highway construction standards. The students decided that removing the viaduct would best benefit the future of transportation in Syracuse in order to support alternative transportation options and to maintain connectivity throughout the city and beyond.

As diagrammed in Figure 29, the I-81 viaduct currently divides downtown from University Hill, two prominent and vital neighborhoods in the center of the city. This prevents ease of transportation between the two and creates a physical divide that prevents movement between the two neighborhoods. The students designed a phase-out option for removing the viaduct keeping knowing that it would be a gradual process to remove the existing and add new infrastructure. Their idea was that gradually, over time alternative transportation would be added to the street, allowing for the creation of new options of travel between the two neighborhoods and beyond.

Figure 28. I-81 Section: Current Condition, Three-Year Plan, and Five-Year Plan

As a conclusion for this report, the team presents the following possible future directions for Syracuse sustainable mobility:

1. Integrating sharing mobility prospects such as bicycle sharing as sustainable alternatives to single occupancy vehicles (SOVs).
2. Implementing comprehensive programs for alternative transportation, possibly using phone applications.
3. Prioritizing sustainable transportation infrastructure for people and the necessary marketing programs.

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