

Impact of Docked Bikes in Columbus, Ohio

EEDS CAPSTONE PROJECT FOR AEDE 4567 IN
COLLABORATION WITH SMART COLUMBUS AND
THE OHIO STATE UNIVERSITY



THE OHIO STATE
UNIVERSITY



Grant Gray | gray.1119@osu.edu | 419-305-9644
Vanessa Nawn | vanessa@nawn.net | 330-217-3827
Parker Siegfried | siegfried.26@osu.edu | 740-972-3144
Joshua Smith | smith.10956@osu.edu | 216-978-5676

Table of Contents

1.0 Executive Summary	2
2.0 Introduction and Framing	2
3.0 Methods	4
4.0 Results and Findings	5
4.1 Current Status of Columbus	5
4.2 Issues of Mobility	7
4.3 Health Incentives	10
4.4 Access for Low-Income Communities	13
5.0 Recommendations	15
6.0 Conclusion	18
7.0 References	18
8.0 Appendices	20
8.1 Appendix A	20
8.2 Appendix B	21
8.3 Appendix C	22
8.4 Appendix D	22

List of Tables

Table 1: Obesity Rates in Franklin County, Ohio	10
Table 2: Differences between Columbus and Philadelphia	15

List of Figures

Figure 1: Health Effects of Bike-Sharing	11
Figure 2: Percent of Low-Income Riders in Philadelphia	14
Figure 3: Breakdown of Riders Using Dock Locations in Low Income Communities	15

1.0 Executive Summary:

Our team of Environment, Economy, Development and Sustainability (EEDS) students at The Ohio State University were tasked with analyzing the current state of bike sharing in Columbus, Ohio. This project is important for the City to address because of the immense amount of changes happening with bike sharing programs. Due to the recent development of Lime discontinuing their dockless bikes in the city of Columbus, it has become increasingly more important to explore where bike share systems in Columbus stand and how it can be enhanced. Many of the questions that were posed to us during the introduction of our project were about which bike system was preferred by riders, if there are parking and safety issues with dockless bike systems, which system is more economically viable for the city and the citizens, and how to address the first and last mile issue of commuting within low income communities. In the course of our research, our team focused on four main objectives to best analyze bike sharing in Columbus. We evaluated the current status of Columbus as well as three other supporting objectives relating to mobility, health, and low-income communities to develop final recommendations for the City. Our major findings were based on researching successful programs in other cities and considering how to apply successful models in other cities to the needs of the City of Columbus.

2.0 Introduction and Framing:

The overall goal of our research was to see how we could assist Columbus in making improvements to their CoGo bike sharing system. To support our research goal, our team set up research objectives that analyzed improving mobility, providing incentives based on the health benefits of biking, and increasing usership by members of low-income communities. With these three topics in mind, the underlying motivation for our research is to provide Columbus with sustainable and alternative transportation options. As bike sharing programs are developing, the

types of bike systems used are constantly being modified. When our project began, there were two major bike systems; the dockless Lime Bikes, managed by the company Lime, and the docked CoGo bikes, managed by the Columbus Parks and Recreation Department and provided by Motivate International, Inc. A few weeks into our research, Lime pulled their dockless bikes out of the Columbus market. In addition to this, we began uncovering other social and economic factors that suggest docked bikes would be a more favorable option for the City of Columbus and our project.

The first of these factors comes from a 2017 NACTO (The National Association of City Transportation Officials) report which estimated 1.4 million trips were taken on dockless bike systems, however, that only makes up 4% of all rides that year; this means that 96% of all trips were taken on docked bike systems (NACTO, 2017). Additionally, even though dockless bikes make up 44% of bike sharing, only 4% of rides are taken on these types of bicycles (NACTO, 2017). The second factor comes from comments our group received from city officials in several different cities. They suggested that some of the primary issues with dockless bikes revolve around safety concerns and aesthetic problems. This is supported by additional findings from NACTO, which state that dockless bikes have “flimsy equipment and limited or no public notification; they pose significant safety risks to the public and are fully divorced from larger transportation planning and municipal needs. People who have used the bikes in the U.S. report that they are of poor quality and often unsafe” (NACTO, 2017).

When considering the question of *whether* to invest in docked or dockless bikes, the above reasons suggest that dockless bikes, although convenient because of their ability to be picked up and left anywhere, have significant flaws that detract from their overall appeal with consumers as compared to docked bikes. In addition to this, there are issues with predictability regarding dockless bikes since the locations where they are found throughout the day are dictated

by whomever uses them last. Finally, Columbus has the infrastructure in place to support CoGo and the planning that comes with the placement of each CoGo dock helps to alleviate concerns about predictability. Motivate International, provider for CoGo, also offers bike valet services that deliver or remove bikes from stations based on their demand throughout the day (Motivate International, Inc, n.d.). This ensures that bikes are in stations when they need to be and addresses safety concerns by making sure any defective bicycles are removed and taken care of. All of these factors suggest that the best path forward for bike sharing in Columbus will involve developing better services and programs for CoGo docked bikes, particularly to address the mobility, health, and low-income priorities we highlight in this report

3.0 Methods:

To recommend the best option for Columbus moving forward, our team performed baseline research on the city of Columbus, (Objective 1), as well as specific benchmarking analysis on cities that supported three additional objectives (Objectives 2-4).

- Objective 1: Existing bike sharing programs in Columbus
- Objective 2: Addressing issues of mobility with existing CoGo stations
- Objective 3: Explore how to incentivize the health benefits of biking
- Objective 4: Explore options for increasing ridership in low-income communities

Our final recommendations for the City of Columbus were drawn from the various interrelated results of our research to achieve each of these objectives.

4.0 Results and Findings:

4.1 Current Status of Columbus

Unfortunately, during the early stages of our research into bike sharing, Lime was engaged with Columbus in legal discussions that barred us from receiving data on their Lime Bike activity. This remained an issue even after they cancelled the program. We were able to obtain data on CoGo, however, as they keep their data available for public use on their website. From that information, we see that today there are 72 dock stations owned by CoGo that have 567 bikes. These stations serve primarily the downtown area and some neighboring towns, such as Bexley and Upper Arlington (Motivate International Inc., 2018). In 2018, there were 40,700 rides on CoGo bikes (Columbus Underground, 2019) which is a bit below the average gathered from their website data of 43,000 since their 2013 launch. The highest number of rides CoGo experienced was in 2017 at over 52,000. To keep ridership rates high, the City is particularly interested in increasing bike share programs in the city and low-income communities for mobility, health, and equity reasons.

Currently, there are organizations in Columbus such as Yay Bikes! that are in place to assist with education and outreach for the community and encourage biking as a mode of transportation. There are a multitude of services provided by Yay! Bikes that help to promote biking in the Columbus area. One is their “How We Roll” program that does rides around the city to see where infrastructure improvements for bikers within the downtown community can be done. An additional program is the “Ride Buddy” program that aims to help encourage biking as a commuting option for work or school. A representative from the organization will come to your house and map a bike route for you from your house to your work location. They will also

ride the route with you the first time to show you any safety precautions that you may need to undertake and show you how to safely arrive at your destination.

The other important biking group with an impact in Columbus is The League of American Bicyclists. This is an organization that provides safety programs and education for biking on a national level, as well as providing ranking systems on how well cities are equipped for bikers. They have previously ranked Columbus and The Ohio State University and as of 2018 the state of Ohio ranks #18 for Most Bicycle Friendly States due to the 18 bicycle-friendly communities within the state. Additionally, there are 46 bicycle friendly businesses and six bike friendly universities within Ohio. Columbus currently has a bronze award for their biking community and the same ranking was given to Ohio State's campus. Bronze is the lowest award that can be given, and the rank is given based on eighteen different criteria dealing with topics of enforcement, education, number of crashes, etc. The entire breakdown of this ranking system is accessible through the link in Appendix D. Smart cycling tips could be part of an education initiative on informing riders how to ride safely in a city to help raise this rank. Gaining a higher rank from this organization could improve the status of Columbus from a national perspective and help gain national attention towards sustainable development goals of the City of Columbus.

At this moment, with dockless bikes out of the picture, the City of Columbus is exploring two large trends in the bike sharing environment. One is a type of bike modeled after a hybrid system that can incorporate both a docked and dockless system into one bike unit. Adopting this type of bike share system is a great way to cater to all citizens because it has the ease and attractiveness of dockless bikes while also providing the structure of docked bikes, which is safer and preferred by the City of Columbus. The other trend that is gaining national attention is

electric and electric assist bicycles. While this was somewhat out of our scope, it is important to take note of for future recommendations of Columbus. One of the biggest developments in the bike sharing programs in Columbus is that Lyft has bought the Motivate company which runs CoGo. This means Lyft will act as the primary sponsor and owner of the CoGo system. Due to how recent this transaction is, Lyft was unable to provide any comments or information for the purposes of our research.

4.2 Issue of Mobility

The second objective our group had was addressing issues of mobility and how CoGo docks could be used to help. When beginning with issues of mobility, we looked at one of Smart Columbus' main objectives: the "first mile - last mile" problem. This means looking at ways in which bike shares can decrease travel times to access public transportation and how to better connect the beginning and ending of an individual's trip. One of the benefits to bike shares is that they can be placed in areas that mass transit does not reach or is not frequently available. Because of the program's success in combining its bike share program with public transportation, our team looked to Capital Bikeshare in Washington D.C. to help generate recommendations for our project. Much like Cogo, ride data for Capital Bikeshare is available in an open source format on their website for the public to reference. Although in Columbus we were unable to get Lime Bike data from Lime, Washington D.C. requires all public bike share companies share their usage data on a monthly basis to the city through an Application Programming Interface (Dockless Data and Application Programming Interface (API) n.d.).

Research that has already been done on docked and dockless bikes in the D.C. area seemed to suggest that Capital Bikeshare, Motivate's D.C. docked franchise, is primarily used to access buildings that are associated with work. Grant McKenzie, a researcher from McGill University in Montreal, Canada, performed a study looking at docked and dockless bikes in

Washington D.C. and noticed that most uses of Capital Bikeshare bikes were heavily focused in the city center. On the other hand, Lime Bikes were used more outside of the inner city and in areas not associated primarily as business centers. His conclusion suggests that Capital Bikeshare is more associated with commuters going to work while the Lime Bike is connected more to leisure activities (McKenzie, 2018). As it stands in Columbus with CoGo, an analysis of the dock locations suggests an opposite goal with the program. We say this because many CoGo stations are located next to landmarks and lining popular social districts such as the Short North and German Village. Some adjustment and/or expansion of the program, which will be discussed later in this section, may be needed to accommodate the best use of CoGo's docked bikes.

As compared to the aforementioned Columbus CoGo numbers, Washington D.C. has over 500 stations with 4,300 bikes that are clustered heavily within the D.C. area (See Appendix B) (Motivate International Inc., 2018), which is roughly 61 square miles. Capital Bikeshare does serve two other cities, Alexandria and Arlington, and is sparsely located throughout Fairfax, Montgomery, and Prince George's counties as well. The primary service area for Capital Bikeshare (D.C., Arlington, and Alexandria) is roughly 102 square miles in size. Including the counties, the potential service area for Capital Bikeshare can top 1,500 square miles where Columbus has just over 218 square miles of potential service area (US City Populations, 2019). As mentioned earlier, there has been an average of 43,000 rides a year since 2013 with 2017 peaking at 52,000 rides taken on CoGo bikes. In 2018, there were 3,543,000 rides taken by Capital Bike Share customers with each bike receiving nine and a half times more uses than CoGo bikes at 824 average annual Capital Bikeshare uses to 87 average annual CoGo uses (Motivate International Inc, 2018).

Obviously, D.C. is an area with a denser population and higher tourist traffic than Columbus, however, some studies suggest saturating the market with docked bikes and stations

nonetheless significantly increases their use. Capital Bikeshare does a bi-annual survey of its users and their most recent survey pointed out three points our team found to be worth thinking about:

1. 71% of Capital Bikeshare members used a docked bike station to access public transportation
2. 65% used a Capital Bikeshare bike to get to work
3. 90% of subscribers said that they would increase their usage if there were more bikes available (Capital Bikeshare Member Survey Report, 2017)

We interpret this as suggesting the best use of docked bikes is as tools for commuting and to serve as a compliment to current forms of public transportation, like COTA buses.

The idea to saturate the market with more bikes comes from the success of international bike programs, specifically, YouBike in Taiwan. YouBike nearly collapsed as a program when they relocated their bikes to favor public transit access points and popular commuter corridors. In 2016, they maintained over 7,000 bikes and plan to install 400 docks by 2019 (Jennings, 2018). When keeping in mind that 90% of subscribers in D.C. would increase their use of bike shares if there were more docks visible and more accessible, we feel that this could be an opportunity to do further analysis with future projects to see how well this would apply to Columbus.

There are some additional variables to consider; for instance, the clientele who responded in Capital Bikeshare's survey were all of a similar demographic: younger (51% under 35), more likely to be Caucasian (80%), more likely to be male (58%), and they live closer to the city center (68%) (Capital Bikeshare Member Survey Report, 2017). There is also competition with the shared scooters that can reduce bike usage, and the further away someone is from a dock, the less likely they will be to use it. Finally, Washington D.C. welcomes a significant number of tourists each year, vastly greater than what Columbus would expect to receive. While it is not possible to determine the demographic information of 21% of users, the majority of rides, about

79% in 2018, were by subscribers who are likely all community members and not tourists. Information on how many rides each subscriber took is difficult to determine and their population is likely going to be significantly less than the unidentified 21%. However, we feel that there is information here that could still be suggestive for Columbus, along with our other recommendations, in identifying how to use docked bikes as an equitable method of transportation.

4.3 Health Incentives

In order to help the city of Columbus reach their goals, our team developed a third objective to investigate, identify, and analyze correlations and connections that can be made between the health of Columbus’ residents and bike sharing programs.

Utilizing qualitative and quantitative data collected from previous research studies that are available to the public, our research team identified three main health challenges that Franklin County residents are currently facing. These include: (1) obesity, (2) failure to meet recommended physical activity, and (3) mental illness. According to the 2017 Community Health Assessment published by Columbus Public Health, one third (30.8%) of Franklin County residents are obese, four out of five (78%) residents fail to meet physical activity guidelines, and nearly one in four adults experience mental illness (Columbus Public Health, 2017). Franklin County’s current obesity percentage of 30.10%, as seen in Table 1, is 0.35% higher than Ohio’s percentage and 2.81% higher than the national average (Columbus Public Health, 2017). Obesity can lead to other illnesses such as diabetes, high blood pressure, coronary artery disease, coronary vascular disease, heart attack, stroke, and cancer (Quiroga, 2005).

Report Area	Total Population Age 20	Population with BMI> 30.0 (Obese)	Percent Population with BMI>30.0 (Obese)
Franklin County, OH	850,756	257,779	30.10%
Ohio	8,478,303	2,553,461	29.75%
United States	226,126,076	62,144,711	27.29%

Table 1: Obesity rates in Franklin County, Ohio

Understanding the health challenges that Franklin county residents currently face, our team recognized that increased investment into the city’s bike sharing program would provide local residents a low-carbon form of transportation while improving the overall health of the community. Bike sharing programs offer local residents easy accessibility to bikes, which decreases rates of leisure-time physical inactivity and directly increases physical activity hours and travel times. As seen in Figure 1 below, this directly impacts injury, pollutants, and exercise which leads to a small but overall positive impact on health (Dafang, 2019). In addition, a research study conducted by the University of Minnesota has recently discovered that on average, obesity rates decline by 1% after the initial implementation of bike sharing programs (Dafang, 2019). This direct cause-and-effect relationship between obesity and bike sharing programs provides quantitative data to further support our recommendations.

Potential Health Effects from Bike-Sharing

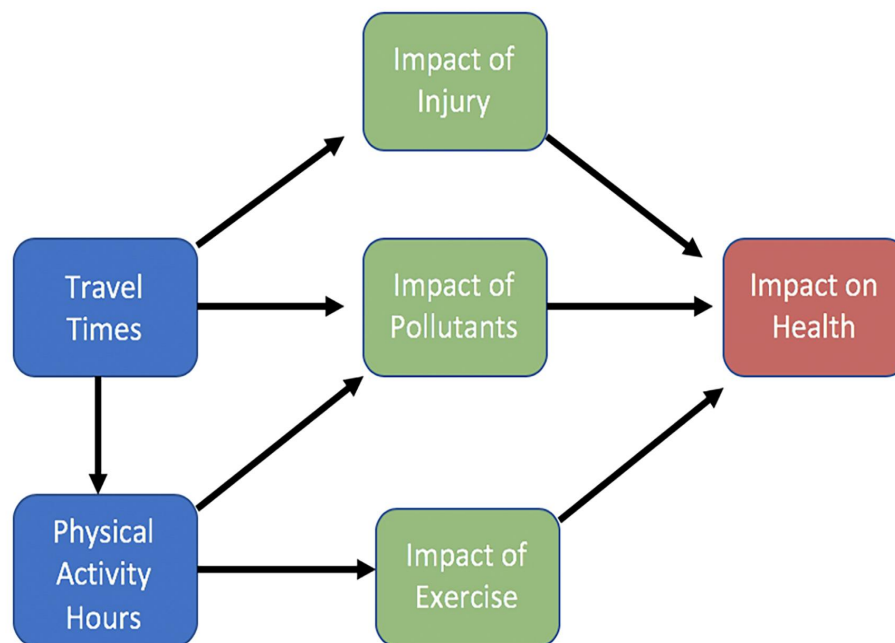


Figure 1: Health Effects of Bike Sharing

In order to better understand the links between bike sharing and health and quality of life benefits, our research team benchmarked Charlotte, North Carolina's bike sharing program. Based on variables such as population size, population density, land area, and median age, our team believed Charlotte contains multiple similarities to the City of Columbus and data collected from this city would be beneficial for Smart Columbus.

To fully understand how bike sharing systems work, we utilized a systems thinking approach to break down the key elements and to observe systems behaviors. This allowed us to discover that health actors, such as hospitals and insurance companies, are critical elements to any bike sharing system. With the key elements identified, our team conducted analysis of website materials and expert informant interviews to understand their role within the system. We learned that Medical Mutual donated \$1.25 million for a 5-year sponsorship to Columbus's bike sharing program that ends in 2019. We also discovered that Medical Mutual has not made any additional investments such as community outreach, educational programs, or monetary investments (CoGo, 2018).

Unlike Medical Mutual of Columbus, Blue Cross Blue Shield and Atrium Health have invested heavily into programs that offer discounts and hosted multiple community outreach events to gain community participation. For example, Blue Cross Blue Shield in Charlotte offers a 20% discount to its members, invested \$1 million into bike lanes and trails, and has coordinated monthly bike share events since its inception. Similarly, Atrium Health provides their employees with a 10% discount on all bike sharing systems and have hosted group bike-sharing events to increase public participation (Bcycle, 2018). These types of efforts could be critical to enhancing CoGo's bike sharing program and a key element to reducing obesity rates in Franklin County.

4.4 Access for Low-Income Communities

The final aspect of dockless bikes in Columbus that we analyzed is the ability of the CoGo docked bike sharing program to include low-income residents within its consumer base. In order to accurately examine this aspect, we first looked into Columbus' current situation. Once Columbus' situation was clearly defined, we benchmarked Columbus' docked bike sharing program with the city of Philadelphia's. We decided to choose Philadelphia for two reasons; the geographic similarities and the similar demographics to Columbus, (landlocked, relatively flat, comparable population), and the success that Philadelphia has seen in the past five years with their incorporation of low-income residents. Philadelphia began its bike sharing revitalization in 2015 when it partnered with the BetterBikeShare organization. The partnership attempted to better Philadelphia's bike sharing program in the five categories displayed in Appendix D. This chart shows the comparison between steps that Philadelphia and Columbus have taken and allows for clear analysis of areas that Columbus has potential to improve upon.

Columbus currently has not taken any direct action to incentivize low-income residents into its bike sharing population. One of the main problems found is that the location of the docks, as shown in Appendix C, are mostly located in higher income areas and areas that attract tourists. This is effective for incentivizing tourists to use the bike sharing system when visiting the city but does not easily allow for Columbus residents to use the bike sharing system for daily commuting purposes. In 2015, when Philadelphia partnered with the BetterBikeShare program, one of their first priorities was to examine the current distribution of docks and redistribute them in a manner that better incorporated low-income communities (Goffman, 2018). This allows for residents to utilize the docked bikes as a staple of their daily commute, getting them to and from major public transportation, often known as the "first mile-last mile" aspect of commuting.

Another one of Columbus' largest shortcomings in regard to increasing low-income consumer usage is creating a discounted program for low-income individuals. In Columbus, CoGo's pricing structure currently has a flat rate for all consumers of \$8 a day, \$18 for three days, or \$75 annually (Motivate International Inc., 2018). Although these prices are competitive across bike sharing programs nationally, the annual commitment can be a struggle for low-income residents to purchase. Philadelphia has slightly more expensive prices for the average consumer, however, it has created a program that charges \$4 monthly for consumers that can prove low-income status (Indego, 2018). The difference here is clear in that \$4 a month is manageable for almost every Philadelphian resident, and when partnered with having a larger number of dock stations that are also more accessible, Philadelphia has been able to increase its number of low-income bike-sharers. Figures 2 and 3 show how important the dock stations are to increasing usage by low-income riders as 80% of the rides taken from these low-income areas are from low-income riders. In addition to this, the average low-income rider takes 1.5 times as many rides as a rider who does not qualify for the low-income program (Indego, 2018), which is often used for the first mile-last mile aspect of their daily commute.

Percentage of Low-Income Riders in Philadelphia

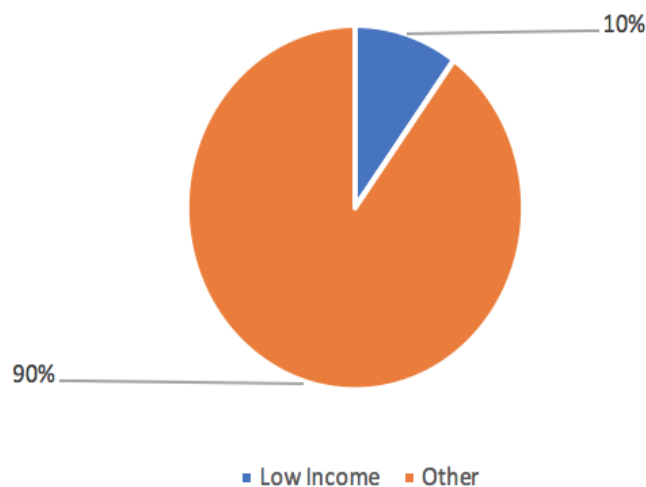


Figure 2: Percentage of Low-Income Riders

Breakdown of Riders Using Dock Locations Located in Low-Income Communities

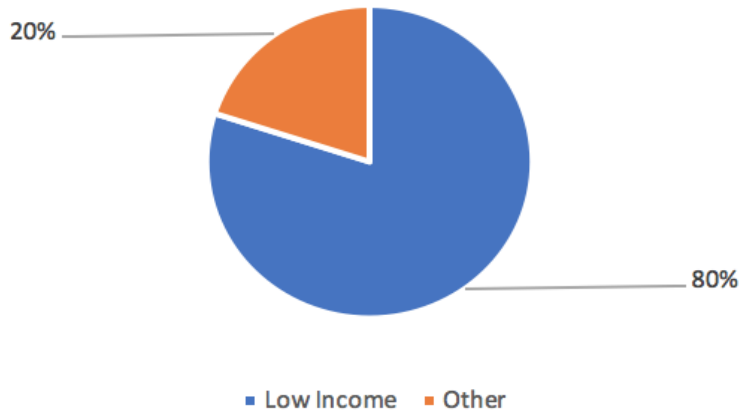


Figure 3: Breakdown of Riders Using Dock Locations in Low Income Communities

Our initial analysis of Columbus’ current bike sharing landscape in regard to its ability to include low-income residents showed poor performance. After benchmarking Columbus’ program with Philadelphia’s recent success, we were able to identify multiple strategies that we believe will allow for CoGo and docked bike sharing in general to better serve the low-income residents of Columbus. A breakdown of the differences between Columbus and Philadelphia can be seen in Table 2, located below.

City	Cash Payment Option	Low Income Discounts	Location Redistribution	Public Outreach
Philadelphia	Yes	Yes	Yes	Yes
Columbus	No	No	No	No

Table 2: Differences between Columbus and Philadelphia

5.0 Recommendations:

Overall, one of the main directions that should be considered for enhancing the bike share system in Columbus is the adoption of a Hybrid Bike System. Systems such as Jump Bikes combine both the ease and convenience of a dockless bike with the organization and structure of a docked bike all into one bike unit. There is also a large push to direct research towards electric and electric assist bicycles. These are two types of bikes that have not been thoroughly researched thus far but are up-and-coming technologies that would work very well in Columbus. On the social side, enhancing groups such as Yay! Bikes is important for assisting in education and outreach for biking as an alternative form of transportation. Supporting these types of organizations are extremely important because of the high levels of growth occurring in Columbus. Because of this, it is becoming increasingly more important to provide alternatives to traditional modes of transport. Promoting biking within Columbus will allow for a decrease of congestion on main roads within the city, as well as decrease issues of parking in areas like the Short North and Downtown.

One of the largest recommendations that Columbus should adopt and explore for the future is a program similar to “Pedal Perks” in Washington, D.C. This means creating partnerships with local businesses, such as restaurants and shops in the Short North and Downtown area, that provide discounts for individuals that use the docked bikes to bike to those specified locations. Due to its success in D.C., we believe this could be a very viable and successful option for Columbus. This would not only allow the Columbus to create partnerships and interest with local businesses which adds value to the City’s economy, but it would provide incentives for citizens to bike.

In regard to mobility, we recommend working with Lyft to target more residential areas, especially in lower income regions, and integrating the use of bike sharing with other public

transportation such as COTA. Challenges have arisen over time including the balance between public and private interests so to enhance this relationship is very important. Due to this transaction being so recent, it is unclear the direction that Lyft is heading, but their coordination with the city is vital for their success. Fostering relationships with the public transportation already in place is also a huge part of Columbus's sustainability goals for the future. There was a recent addition of bike racks to the COTA buses; however, there is lots of room for improvement on how CoGo bikes can be integrated more to be supported by the locations of the COTA bus stations.

To directly address health related issues and incentives, our team discovered that health actors, such as hospitals and insurance companies, are critical elements to any bike sharing system. While collaborations between hospitals and insurance companies are being created, those relationships need to be enhanced alongside the development of discounted programs to incentivize health. For example, in Charlotte, North Carolina, the insurance company Blue Cross Blue Shield has funded the bike share system, (an investment of \$2.25 million dollars), with the goal of trying to increase physical activity within the city. Although Medical Mutual will not be renewing their partnership with CoGo, programs similar to "prescribing a bike" can be revitalized to encourage and incentivize citizens to use the bike systems more. This is a program that used to be in the area but for hiking, where doctors would write you a "prescription" to get out and hike on the trails within Columbus. This program can be applied to biking as a way to get more people on the bikes which would stimulate business for CoGo and the Columbus economy.

The main takeaway of our low-income research is to begin to adapt ideas that have worked in Philadelphia for use in Columbus. Currently, Smart Columbus is in the process of designing a Common Payment System for all modes of public transportation. This will include a

cash option that benefits low income residents, but it is not yet launched. Additionally, Columbus should consider a partnership or participate in consulting with BetterBikeShare Partnership to improve programs with CoGo. A main part of their program is to work with cities to improve their bike sharing systems and Columbus would be a perfect candidate. If Columbus considered the potential of saturating the low-income areas with more dock stations, adding a discounted program for low-income residents, and collaborating with local non-profits or government entities to increase public outreach, low-income residents would have the opportunity to participate in this mode of transportation in a way that is affordable and accessible.

6.0 Conclusion:

As the bike sharing world is rapidly changing, it has become increasingly important to more closely examine what can be done to improve the use of bike sharing. With dockless bikes becoming obsolete, a focus on docked bike systems seems to be important in deciding the future for bike sharing programs. Providing biking as a more accessible and commonly used alternative form of transportation is extremely important for Columbus because it reduces carbon dioxide in the atmosphere, improves the health of citizens, and can increase social capital of community. We hope our recommendations can help improve the positive impact of Columbus bike sharing options.

7.0 References:

- 1) Bicycle. (2018, February 2). How it works. Retrieved from <https://charlotte.bicycle.com/>
- 2) Dockless Data and Application Programming Interface (API). (n.d.). Retrieved from <https://ddot.dc.gov/page/dockless-api>
- 3) Engel, A. (2017, April 13). Rogue Bike Share Providers Raise Concerns For Cities. Retrieved April 15, 2019, from <https://nacto.org/2017/04/13/rogue-bike-share-providers-raise-concerns-cities/>

- 4) Engel, A. (2018, May 1). NACTO Releases Updated Nationwide Bike Share Ridership Data. Retrieved April 15, 2019, from <https://nacto.org/2018/05/01/nacto-releases-updated-nationwide-bike-share-ridership-data/>
- 5) Goffman, E. (2018, July 18). Bikeshare has an equity problem, and Philadelphia is tackling it. Retrieved April 15, 2019, from <https://mobilitylab.org/2018/07/18/bikeshare-has-an-equity-problem-and-philadelphia-is-tackling-it/>
- 6) Indego. (2018, April 12). Passes. Retrieved April 15, 2019, from <https://www.rideindego.com/passes/>
- 7) Jennings, R. (2016, March 16). Gearing up: How Taipei's bike-sharing program is transforming citizens' commute. Retrieved from <https://www.theguardian.com/sustainable-business/2016/mar/16/taipei-taiwan-bike-sharing-environment-cycline-air-pollution>
- 8) McKenzie, G. (2018). Docked vs. Dockless Bike-sharing: Contrasting Spatiotemporal Patterns. Retrieved from <https://grantmckenzie.com/academics/Dockless2018.pdf>.
- 9) Meet CoGo Bike Share. (n.d.). Retrieved from <https://member.cogobikeshare.com/stations> System Data. (2018, May 5). Retrieved from <https://www.cogobikeshare.com/system-data>
- 10) Motivate International, Inc. (2018). How It Works: Columbus' Most Popular Bike Rental. Retrieved from <https://www.cogobikeshare.com/how-it-works>
- 11) Motivate International, Inc. (2018). CoGo Bike Share Membership & Pass Options. Retrieved April 15, 2019, from <https://www.cogobikeshare.com/pricing>
- 12) NACTO. (2017). Member Cities. Retrieved April 15, 2019, from <https://nacto.org/bike-share-statistics-2017/> -<https://nacto.org/member-cities/>
- 13) The League of American Bicyclists. (n.d.). Home Page | League of American Bicyclists. Retrieved April 15, 2019, from <https://www.Bikeleague.org/>
- 14) *US City Populations 2019*. (2019). Retrieved from World Population Review: <http://worldpopulationreview.com/us-cities/>
- 15) Yeager, S. (2019, March 14). Why This Health Center Prescribes Free Bike-Share Memberships. Retrieved April 15, 2019, from <https://www.bicycling.com/news/a20021305/prescribe-a-bike-new-york/>

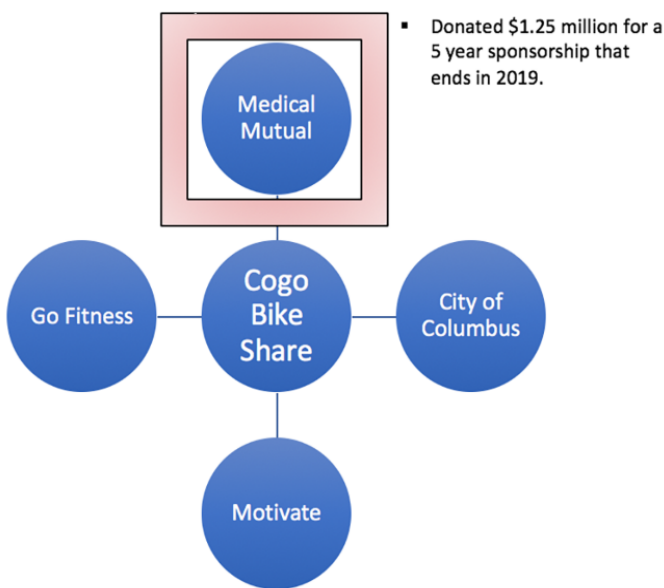
16) Xu, D. (2019). Burn Calories, Not Fuel! The effects of bikeshare programs on obesity rates. *Transportation Research Part D: Transport and Environment*, 67, 89–108. <https://doi.org/10.1016/j.trd.2018.11.002>

17) 2016 Capital Bikeshare Member Survey Report. (2017, February 24). Retrieved from https://d21xlh2maitm24.cloudfront.net/wdc/Capital-Bikeshare_2016MemberSurvey_Final-Report.pdf?mtime=20170303165531

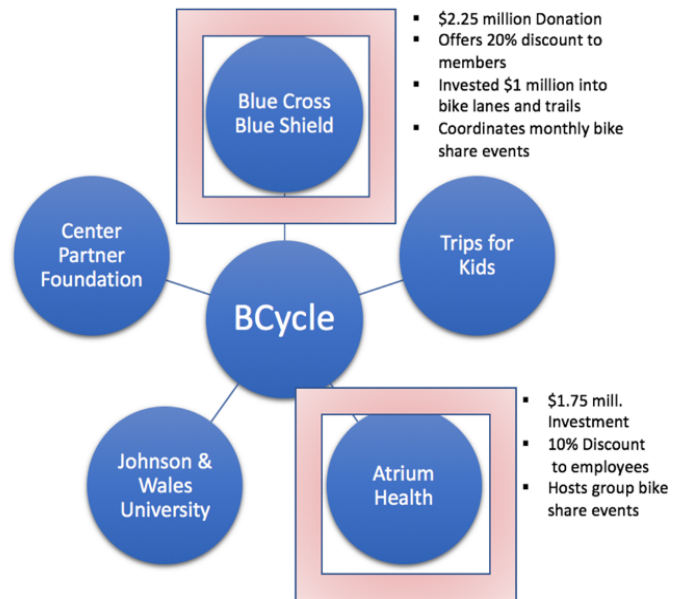
8.0 Appendices:

Appendix A: A comparison of the actors involved in bike-sharing in Columbus, Ohio and Charlotte, North Carolina.

Bike-Share Health Actors

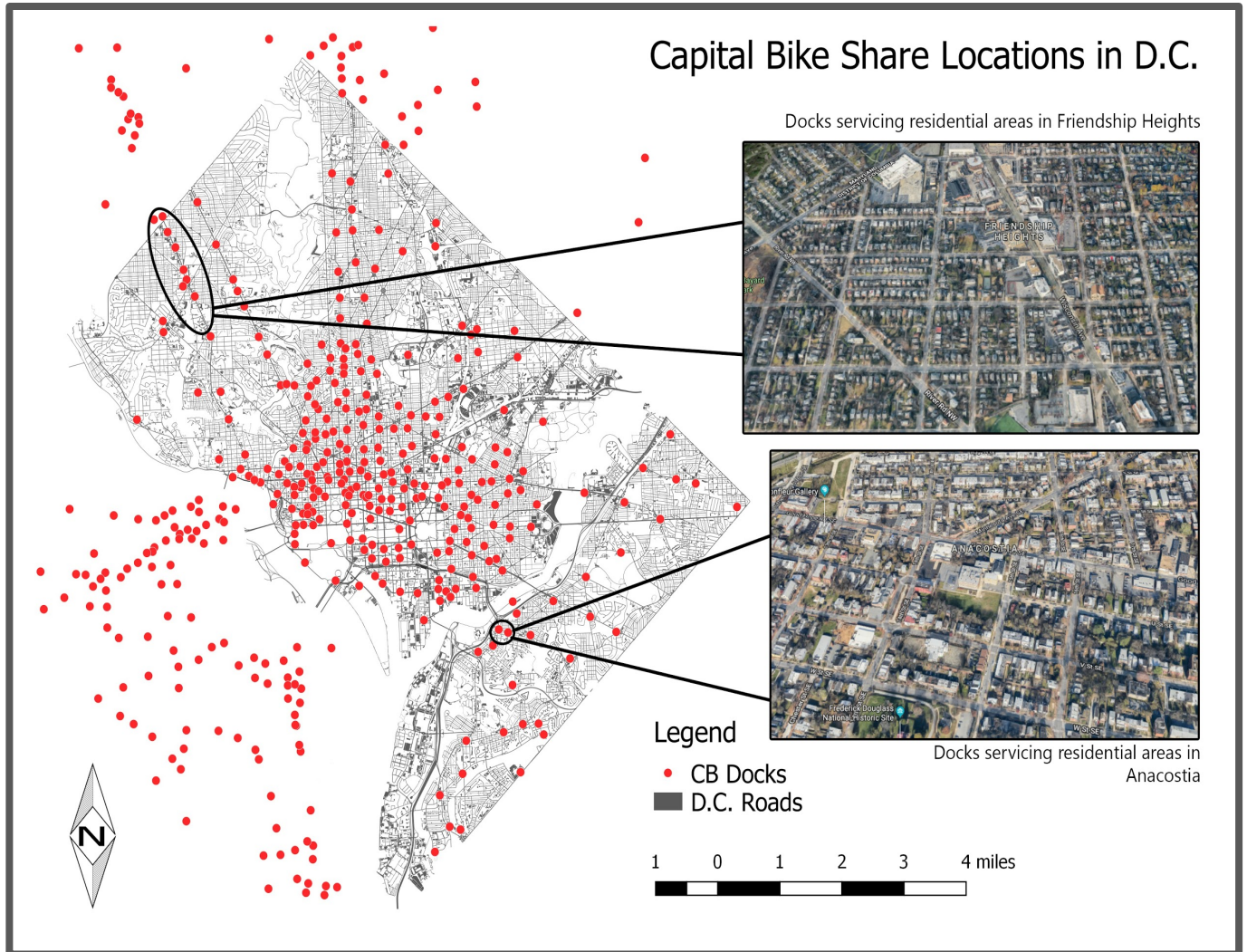


Columbus, OH

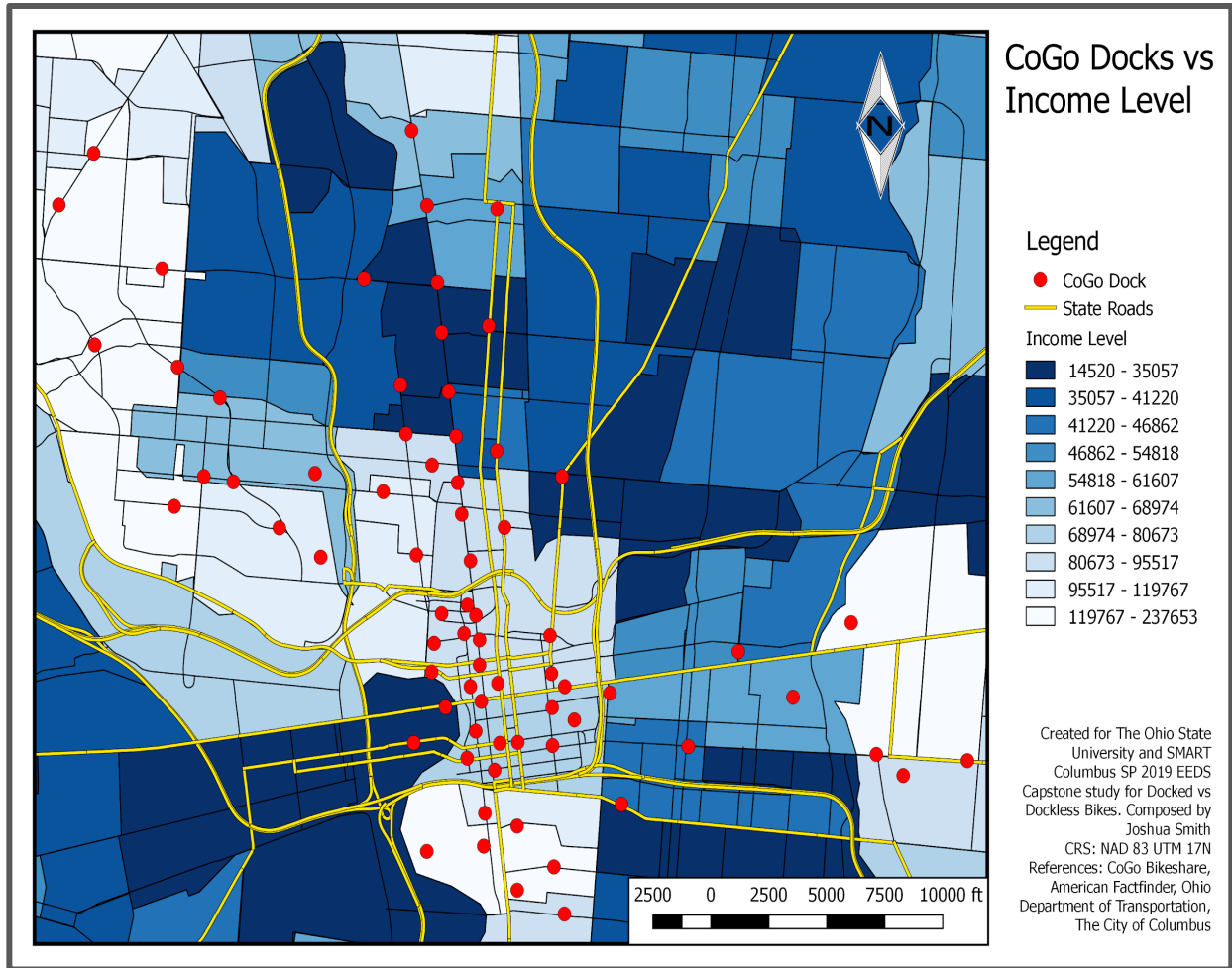


Charlotte, NC

Appendix B: Washington D.C.'s Capital Bike Share locations shown over the D.C. corp. Line



Appendix C: CoGo Bike locations with income overlay



Appendix D: Link to how The League of American Bicyclists ranks cities and communities;
<http://bikeleague.org/sites/default/files/BFC%20infographic.pdf>