

Comprehensive Public Transportation

Green Memo III

Section C.5

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Executive Summary

The overall goal of this project is to address Objective C.5. of Columbus' Green Memo III to reduce the amount of people driving alone to work to 70% over the next five years. Columbus' Green Memo III is a green community plan for Columbus, Ohio to plan and guide for future sustainability initiatives throughout the city. Specifically, this project addresses Action 4 of this objective to “strategically plan for a comprehensive, future-oriented system of public transportation that fully integrates appropriate rail transit, bus rapid transit, and enhanced overall bus service (Green Memo III).”

To capture the broad scope of this project, this report takes a bird's eye view of public transportation as the most logical approach in understanding steps Columbus should take to reach their goals. In order to achieve this, five cities were chosen as case studies to assess and compare various aspects of public transit as they relate to five categories: cars, buses, bikes, walkability and alternative (light rail, trolley, etc.). These cities were Indianapolis, Austin, Minneapolis, Charlotte, and Paris. Each were analyzed to determine best practices throughout all of the cities, as well as issues that each came across and why. The cities varied in success made in developing a comprehensive public transportation plan. Based off the five categories, it was clear that Paris and Charlotte have the most progressive transportation programs in place, but that all cities are surpassing Columbus' transit plan. Based off the five case studies and an interview with Olaf Kinard, the director of marketing and communications for the Charlotte Area Transportation System, the team developed three recommendations for the city of Columbus: organize a unified transportation administration, develop incentive programs through employers, and focus on implementing a light rail system and HOV lanes.

Introduction

The Columbus' Green Memo III is a green community plan for the city of Columbus, Ohio. It provides Columbus with a plan and guide for investment in potential sustainability initiatives. Objective C.5. of Columbus' Green Memo III was addressed in this project, which was to reduce the amount of people driving alone to work to 70% over the next five years. Specifically, addressing Action 4 of this objective to “strategically plan for a comprehensive, future-oriented system of public transportation that fully integrates appropriate rail transit, bus rapid transit, and enhanced overall bus service (Green Memo III).”

To achieve this, five cities were chosen as case studies to assess and compare various aspects of public transit as they relate to five categories: cars, buses, bikes, walkability and alternative (light rail, trolley, etc.). The case studies chosen are great examples for the city of Columbus to see the processes that other cities went through to get to where they are today. They can see what went well, what didn't work in each city, and why it turned out this way. This allows Columbus to learn from others' mistakes and take advantage of their steps to success to implement here in Columbus.

Three patterns arose based on information collected in the case studies and led to three major recommendations that Columbus should take into consideration. The first recommendation is to create a unified and comprehensive committee or administration to overlook all aspects of the transportation plan. The next recommendation is for that committee to create incentive programs that employers could provide to their employees and job seekers to increase ridership. Finally, the third recommendation is to not shy away from the idea of larger scale transportation systems, like light rail, just because they experience a lack of ridership in their current transportation options.

Based on these trends, Columbus should implement HOV lanes and light rail, improve upon pedestrian and bicycle accessibility and safety, incentivize carpooling through HOV parking, adjust traffic patterns, and unify public transportation efforts and programs under one single umbrella organization to manage all of these. Information and supporting evidence on how these recommendations were developed is presented below.

Methods

Initial stages of the project involved brainstorming and researching very specific plans regarding public transportation options for the city of Columbus. There were three recommendations that were thought to be the best next steps for Columbus. The first was step to implement HOV lanes on the outer belt to help with commuter times for those who decided to carpool or take the bus. The next step was to expand bus routes to reach more suburban areas since many workers in the city commute from the surrounding areas due to urban sprawl in Columbus. This would also encourage more ridership on COTA, as buses would have shorter commute times when using HOV lanes. Finally, consider larger scale and more long-term goals such as: elimination of parking on High Street to encourage more carpooling, creation of space for bike and bus lanes, and implementation of rail. This would allow for more convenient and faster public transportation options, while creating a foundation in case the city later wanted to upgrade to a longer term investment of light rail.

Many people thought these were great ideas, but suggested it may be best to take a broader approach. Taking their recommendations into consideration, it was decided to perform case studies on five cities that embodied Columbus' needs. The five cities chosen to study were:

- Austin, Texas
- Charlotte, North Carolina

- Indianapolis, Indiana
- Minneapolis, Minnesota
- Paris, France

The transportation systems of these cities were then analyzed for best practices to fit Columbus. What did they already have in place? What has been proposed? What steps did they take to get there? What made them successful? What were their failures or setbacks? All of these findings helped determine what would be the most logical next steps for Columbus to take.

Since the overall goal was to decrease the amount of single drivers, cars, buses and light rail were given the most priority. Walkability and bikes were not emphasized as much due the distance many commuters in Columbus travel. Also by addressing transportation by cars, buses, and light rail there could be positive spillover effects into walking and biking.

Columbus, Ohio

In order to get a baseline of the current public transportation system in Columbus, it was important to do a small case study on the city to see what they had already done or proposed and why it had or had not worked. This would allow for connections to be made when comparing the other five cities to Columbus.

Starting in the late 1880s, electric streetcars were used as a form of public transportation. In the early 1900s these were converted to trackless trolley buses. (Columbus Railroad). Lack of investment in repairs, popularity of cars, and introduction of buses led to a phasing out of these by 1965 (Vitale, 2008).

Currently, Columbus has buses, bike share, and car-share programs. There are a few small carpooling options found within organizations, but not an overarching one that could connect drivers and passengers from all over the Columbus area. There is also a Bus Rapid

Transit in the works that should be introduced to the city by 2017 (COTA, 2014). These are great first steps, but all have fairly low ridership compared to many places, therefore there are opportunities to improve and grow. It was also discovered that Columbus is the 16th largest city in the USA according its population, and the largest city without a rail system (Census.gov). There have been many proposals from various individuals and organizations to bring rail back to Columbus, however none of them have seemed to go anywhere due to financial, political or organizational hurdles (Vitale, 2008).

Indianapolis, Indiana

Indianapolis was chosen because of the similar demographics and transit system. Indianapolis' city population is 852,866 and Columbus' city population is 822,553. The Indianapolis metro population is 1.83 million and Columbus' metro population is 1.9 million. Both of these cities are capital cities and are blooming cities in the Midwest area. Both cities have dominant car cultures, and a lack of light rail (Meckstroth, G.).

Indianapolis is one step ahead of Columbus when it comes to establishing a comprehensive transit plan. In 2008, a public opinion poll showed the public desire for improved mobility in Central Indiana and the willingness to fund the project. In 2010, Indy Connect, Central Indiana's Transportation Initiative, was launched. There were many public hearings to get feedback on the plan in order to create a long-term vision. Most recently in February 2015, a rapid transit line started to take shape and is being presented to the Indianapolis Regional Transportation Council (Sheridan, J.).

Columbus is behind Indianapolis in that such a plan has not been established and there is not readily available funding if something were proposed. It would be beneficial for Columbus to look at steps that Indianapolis took. The plan that was proposed includes:

- Buses, with the goal of doubling the current service and tripling the size. This would mean less wait between buses and longer hours of service including more direct lines.
- Rapid Transit Lines would include five new lines put in place in the most traveled areas; this would include light rail and bus rapid transit.
- Bike and Pedestrian Pathways would increase and improve current trails and pathways to fill any gaps between buses, rail, or roadways.
- Roadways and bridges would include expanding and improving the current infrastructure of roads and bridges. Also proposed is the addition of high occupancy lanes (HOV) and express toll ways to decrease single rider drivers (The Indy Connect).

Despite efforts, Indianapolis struggled with lack of implementation. They had a great plan and something that Columbus should take into consideration when developing their own comprehensive plan. It is recommended to look at how they are obtaining funding and changes they are making to their legislation to implement the plan. The lack of implementation beyond legislation and their uncertainty of the future resulted in Indianapolis being unsuccessful. Columbus can take note of the obstacles they encountered and try to adjust as best as possible.

Austin, Texas

Austin, Texas is comparable to Columbus in terms of population and population density. It also has similar dynamics to the city of Columbus and Ohio State because the University of Texas is located in Austin. According to U.S. Census Bureau data, Austin experienced over a 12% growth in population from 2005 to 2010, and has no signs of stopping. Given the rapid growth in the region, the city understands the need to improve public transportation to maintain access to and from the city center.

Capital Metro is the provider of public transportation in Austin, Texas. It was established in 1985 and now includes a bus and rapid bus system, commuter rail, and rideshare programs. Both the buses and the rail vehicles are equipped with bike racks and there are several bike shelters at select stations. In order to make public transit financially feasible for residents, Capital Metro offers reduced rates for students, Medicare cardholders, people with qualifying disabilities, and military personnel (Capital Metro).

The city buses serve nearly 3,000 total bus stops through 80 different routes around the city. The Metro rapid bus system has 43 stations. In 2013, over 600,000 trips were made via bus. The rail line is also a part of the Metro system and began running in 2010. It includes 43 stations along Route 801 and 34 stations along Route 803 to connect the city with the suburbs. The rail lines have free Wi-Fi, which is an incentive to increase ridership. From 2010 to 2013, average monthly ridership for Metro Rail increased from 18,000 to 64,000 (*Capital Metro*).

Another service provided by Capital Metro is a rideshare program. Groups of riders are able to lease vans to use for car-pooling on a month-to-month basis. The program is ran through vRide, a national rideshare service that has a contract with Capital Metro. Although this service is not run directly by Capital Metro, it is currently accessible by residents through the organization (Capital Metro).

Bus and rail riders in Austin saved 223 gallons of gas and 4,400 miles of driving per year (Austin, Texas). According to the American Public Transportation Association, a single commuter using public transportation in Austin rather than driving every day can reduce up to 5,000 pounds of carbon dioxide per year (Austin, Texas).

The highways around Austin, Texas do not offer HOV lanes. However, an extensive project began in 2013 to expand I-35 and add lanes to decrease congestion leading into the city. This project is conducted through the Texas Department of Transportation (Austin, Texas).

On top of the services provided by Capital Metro, the Austin Transportation Department is making strides within the city to improve walking and biking options as an alternative to driving. The 2013 annual report from the department outlines the plans to develop and expand bike lanes as well as sidewalks throughout the city. The report also lists increasing walkability as a major community goal (Austin Mobility: Moving Forward). In 2013, the city received \$1.9 million in federal funding to expand 1.6 miles of sidewalk in the city. The transportation department also offers educational programs to increase bike safety awareness (Austin, Texas).

When planning for future population growth, Columbus should consider the success of the commuter rail in Austin in terms of increasing ridership and decreasing people driving into the city. Columbus should also recognize the value of a unified structure of the transportation administration in designing and implementing a comprehensive public transit system.

Minneapolis, Minnesota

Even though the city of Minneapolis has only about half the population as the city of Columbus, the two cities still share very similar demographics. They have similar education levels, household income, age of residents, and university presence (FindTheHome). Therefore, Minneapolis makes a great comparison when it comes to facing similar problems and ways to overcome them.

The Minneapolis Plan was first created in 2000 as a very general idea to plan where the municipal government would like to see their city in the future. By 2009 the City of Minneapolis created a new, much more detailed and in-depth plan called the Minneapolis Plan for Sustainable

Growth. This plan was amended in 2011 to expand its focus to even more opportunities (City of Minneapolis). The final draft included 10 topics of interest which include land use, housing, economic development, public services, open spaces and parks, urban design, heritage preservation, arts and culture, environment, and transportation. Within the transportation section they proposed 10 policies they wanted to see improved upon within the city (The Minneapolis Plan). The main topics these policies covered were:

- Cars: reduce driving alone to work to 61%.
- Walkability: ensure routes are safe, comfortable, pleasant and accessible.
- Bikes: ensure bicycling through the city is safe, comfortable, and pleasant.
- Buses: make transit a more attractive option for new and existing riders.
- Alternative: support the development of a multi-modal downtown transportation system that encourages an increasingly dense and vibrant regional center.

Minneapolis has made a lot of progress since their first idea of a plan in 2000. They have decreased single drivers, improved walkability, increased bike accessibility, and added to their existing rail lines. These things were made possible by creating HOV lanes on the interstate surrounding the city, introducing bus rapid transit, creating rideshare and bike-share programs, and by improving upon their existing rail system (The Minneapolis Plan). However it was anything but easy to accomplish. They had many setbacks when it came to funding and public support. At first, many citizens were worried about gentrification when it came to expanding the rail lines and additional lanes for buses. However, the city made sure they had alternative affordable housing options to provide for the citizens who were displaced during this process. The construction also ended up bringing more jobs, culture, and business to the surrounding areas where every resident could benefit (Hargreaves & Aratari). When it came to funding they

had to rely on a variety of state and federal funding options, but eventually reached their goal (The Minneapolis Plan).

Overall there were two major factors that led to the present success of the policies in the transportation section of The Minneapolis Plan for Sustainable Growth. The first being the fact that they did not shy away from the idea of large investments into bus rapid transit or rail, due to low ridership on current transportation options. The first year the rail was implemented, it surpassed expected ridership by about 25% (MetroTransit). Within the first eight years (2004-2012) the rail ridership had more than tripled from about 2 million riders per year to over 10 million riders per year (MetroTransit). The number of riders had not been seen on any other form of public transportation before the rail was implemented and was a great investment for the city despite the previously projected lower ridership.

The second success factor was the formation of a single organization that dealt with all of the city's transportation needs, MetroTransit. This is one organization with one website that users can go to find all the information necessary for their travel needs. The metro passes that they purchase can be used for both the buses and rail, which increases the convenience for users. Low and reduced fare options are provided for the unemployed to help them where they need to go during their job search, or for employers to incentivize their employees to take advantage of public transportation (MetroTransit). The Minneapolis transit website also provides car share and carpooling options for residents city-wide. Having one umbrella organization in charge of all of these programs has made it very easy for residents to have a convenient and positive experience when it comes to public transportation, and was therefore extremely beneficial to Minneapolis.

Minneapolis owes much of its success to its impeccable comprehensive plan that one umbrella organization has created. It covers not only what could be done for the city, but

estimates costs, plans for funding, provides a timeline and course of action, and assigns responsibility for each action that will be undertaken. If Columbus could take a few ideas away from Minneapolis it should be to mirror their actions for rail implementation, create one unified planning organization and carry out their precise planning process and detailed documentation skills which were necessary to Minneapolis's success.

Charlotte, North Carolina

Charlotte is comparable in population and demographics to Columbus, and both cities have a major university. Charlotte developed their comprehensive public transportation administration in 1999 and over the years has overcome some of the same public transportation barriers that the city of Columbus is facing today.. This committee is fully responsible for all of Charlotte and the metropolitan areas public transportation; buses, bus rapid transit, light rail, car and vanpools, bike lanes and routes, and improving/ expanding their walkability and land use. Charlotte has divided their administration into marketing and communications, financial, operations planning, rail operations, and safety and security. Charlotte Area Transit System (CATS) is ran by a board that helps set long term plans and goals and is advised by two citizen-based committees, Citizens Transit Advisory Group and the Transit Service Advisory Committee (About Charlotte Area Transit System).

In 1980, Charlotte's city council decided it was necessary to address the city's growing population. With this growing population the city was looking forward to expanding development projects and working on attracting new business opportunities. In 1984, the city partnered with the local university, University of North Carolina at Charlotte, to help develop Charlotte's 2005 Vision Plan. Beginning in 1988 Mayor Sue Myrick collected \$185,000 from a campaign to raise funds to develop a strategy to incorporate a light rail system with three lines

that would connect the downtown, university, and airport. The final report predicted a total cost of \$467 million. The city council agreed to issue \$101 million in bonds; however, due to lack of financial support the project was halted and ultimately evaluated as a failed project. The Charlotte Area Transportation System initiated a second attempt at the light rail project in 1990 when they were allotted \$14 million, although the initial project proposal by the university did not anticipate adequate ridership. This led the city to a 15 year long debate, but voters finally ended it by increasing sales tax by \$0.50. This allowed the Federal Transportation Administration to match the sales tax. The construction began in 2000 and after having to increase the expected cost of the light rail project; it was finally completed in 2007. The first operating line called the blue line runs through the downtown area. The grand opening day allowed passengers to ride for free and to the planning committee's surprise, reached the rail lines' maximum rider capacity. Ridership estimates for 2025 were doubled from 9,100 riders to 18,100 riders. The first year ridership had doubled their projection and surpassed the 2025 estimation (Lynx Rapid Transit Services).

Olaf Kinard (2015), the director of marketing and communications, stated:

“In 1999, the Ambient Air Quality Improvement Act (Senate Bill 953) targeted a 25 percent reduction in the growth of commuter Vehicle Miles Traveled (VMT) by July 1, 2009. North Carolina surpassed this goal by reducing the growth of commuter VMT by 25.2 percent. In order to make this accomplishment possible, the Public Transportation Division (PTD) expanded its Transportation Demand Management (TDM) Program,”

The North Carolina Department of Transportation invested 50% of the cost to increase TDM's administration. This allows the improved administration to undertake several activities to reduce VMT. Some of these activities include commuter challenges, creating programs that help

employees of certain organizations to ride public transit for little to no charge, and provides information to commuters about alternative commuting (Kinard, O).

The VMT Report (2014) found that:

“According to FY 2014 figures, the projected growth of commuter VMT has been reduced by 26.3%. This reduction in growth has been calculated annually based on commuter trips via public transit, light rail, vanpool, and carpool. From 2000 to 2014, with commuters using carpools, vanpools and transit, daily commuter VMT increased by 26.27 million. If commuter trips had not been accommodated using alternative modes of transportation, daily commuter VMT during this time frame would have increased by 33.18 million. This represents a 26.3% reduction in projected growth of commuter VMT. Interestingly, FY14 saw an increase in the amount of carpool and vanpool participation across the state”

Olaf also stated in his interview that a major challenge Charlotte faces is the city’s rapidly growing population. With 5,000 new residents moving into the area and the bulk of VMT coming from extracurricular activities, the city has put a significant amount of effort to develop land use strategies (Kinard, O).

Paris, France

For over 100 years Paris has been developing a comprehensive public transportation system. It encompasses a metro line, extensive bus system, bike share program, and RER lines that extend beyond the city to surrounding towns. The metro line services 5.23 million people, nearly half of the metropolitan population (12.2 million) (RATP, 2014). The city has over 4,490 buses, 12,500 bus stops, and nearly 1 billion journeys each year, servicing more than 200 towns outside Paris (RATP, 2014). The RER lines are double decker trains connecting even further

areas outside the city with 46 stations along the different lines (RATP, 2014). The Paris system is as extensive as public transportation comes and they continue to invest in expansion. This system also connects to the French national train line, SNCF, to get people anywhere they need to go. Paris was chosen to be a long-term look at what public transportation should and could be in the city of Columbus. Their RER lines could serve Columbus well as an example because of the urban sprawl associated with the city. What Columbus could do is implement a main line along a busy area such as High Street that would drive demand for people and businesses to be located near the line. From there, the surrounding suburban towns could contribute funds to connect their districts to the Columbus main line, while all operating under one umbrella.

Other reasons why Paris was chosen as a model is because the Parisians and the French for that matter have a similar mentality to Americans and the citizens of the Greater Columbus Metropolitan Area. In order for a city to have a thriving public transit system it must be cost effective (more affordable than driving) as well as quicker and more convenient.

Columbus will need to think very long term in regards to their plans especially as the United States undergoes an infrastructure overhaul and federal funding may or may not become available. There may be two possibilities on what the country decides to do. The highway infrastructure could be replaced or some funds could be distributed to build an advanced network of passenger trains similar to Europe, especially as people migrate back into the cities. If the United States does choose to devote resources to advanced national passenger train system, Columbus would need to put themselves on the map as a contender for the implementation of new rail lines and would therefore need a light rail system to make their case.

Paris should serve as a long-term model in comparison to the other case studies. Scaling down Paris to fit Columbus' needs is critical. Another point of importance to understand is that

implementing a public transportation plan will not fit everyone's needs. Some people will need to drive for work purposes (work trucks etc.) and others will continue to walk or bike. By implementing a plan that encompasses the needs of many, including rideshare programs, Columbus can make a pivotal step towards developing a plan that fits their needs.

Other aspects of Paris that should be considered is that even though Paris is considered one of the best public transportation systems in the world, it still has issues such as air pollution from passenger vehicles. Last year on March 17th, 2014, Paris implemented an even/odd license plate ban to curb the air pollution from motor vehicles (S.P. 2014). By understanding the hurdles and opportunities Paris has taken to develop their transportation system, Columbus can learn what steps will best fit them. Paris is relevant to Columbus in the long term, as a comprehensive plan encompassing light rail and connecting lines to suburban areas and a possible national passenger rail system. It's important to use Paris as a long term model for continued population growth.

Recommendations

Olaf Kinard, the director of Marketing and Communication for CATS, referenced the importance of having a unified administration that is large enough to handle major projects along with the ability to undertake every public transportation need. Olaf directly attributed the success of Charlotte's transportation system by unifying and increasing the reach of their transportation administration. Therefore the first recommendation to Columbus is to unify the multiple non-profit groups, community organizations and COTA to have a core transportation administration under one umbrella to expand and build upon every public transportation need.

The second recommendation to Columbus after establishing a unified transportation committee is to develop incentive programs through employers. Several cities have successfully

increased the ridership of the available public transportation and reduced the number of single drivers by creating programs that incentivize employers to: lower/ eliminate employee fares, provide job seekers with free fares, organize car and van pools for employees, and develop user friendly websites and programs for public transportation trip planners to access with ease. These incentive programs would not only work for a light rail system but could also work for the bus services and car or van pools.

The final recommendation is to not eliminate the possibility of a light rail system due to concerns of a lack of ridership with other forms of transportation, such as COTA. Charlotte and Minneapolis are great example of cities that implemented a light rail project even when ridership projections were not promising. Charlotte's light rail ridership doubled estimations for not only the first year but the long-term ridership estimates for 2025 as well. Out of the frequent users of the light rail in its first year of operation, 72% of riders had never used public transportation before. Minneapolis had a different experience with their light rail ridership, however the ridership continually increased from year to year. When the light rail first opened in 2004 the ridership was 2,938,777 riders per year. By 2012 the ridership had increased to 10,498,236 riders per year.

Conclusion

There were three key findings across almost all of the five cities through the case studies. The first was that public transportation is necessary to address population growth. Continued expansion of public transportation must take place year to year to adapt to this growth. This impacts current infrastructure, and may call for an infrastructure upgrade such as light rail that can handle a larger population. It must be taken into consideration that a city may have to readjust the goals, because as population growth may make some goals unrealistic to reach. The

next trend observed is that employer incentives are extremely helpful when it comes to increasing ridership. Especially in Charlotte and Minneapolis, when employers provided free or reduced fares for their employees or for those seeking employment, an increase in public transportation ridership was observed. This made citizens become more comfortable with the system and many began to use it outside of their commutes to and from work. Finally, the third finding was that cities with new or non-unified committees, like Columbus and Indianapolis, struggle when it comes to implementation due to funding issues, lack of ridership, and conflict with politics and public support.

Taking the results from the case studies, findings, and recommendations into consideration there are several next steps that would be logical for Columbus to take:

1. Unify public transit and its subsidiaries including COTA and MORPC under one umbrella
2. Implement HOV lanes on surrounding outer belt of 315 and I-71 within the Columbus metropolitan area
3. Develop bus and bike lanes along High St
4. Move North & South car traffic to Summit St and 4th St
5. Implement a light rail line along High St from Hudson St to Main St. The city of Columbus could fund the main line and areas such as Upper Arlington, Clintonville and Westerville to name a few, could fund their own connecting lines to the main hub.
6. Incentivize HOV parking

Taking these steps would encourage more participation in the public transportation sector. People want the convenience as well as the ability to save time and money. There will only be a decrease in single drivers throughout Columbus if the city can create an effective plan

that is convenient for the users and will give them a faster, cheaper and safer alternative to what they already have. For Columbus to not only compete, but also thrive in the global market, it is crucial to have a transportation system that reaches and sets the highest standards.

Problems and Opportunities for Future Extension

Some of the main issues that the team encountered were figuring out the correct scope of the project. It took the team a few weeks before they decided on the official direction they wanted to take, as there were many options. Another problem was getting in contact with city officials and transportation experts. The team reached out to many contacts with limited success hearing back. However, in the end the group ended up finding a lot of useful information that was necessary to complete this report especially from Olaf Kinard of CATS.

This project has a very broad scope and covers a lot of data. This would be a great project to continue carrying out in future years. It will allow for next steps to be taken in hopes of seeing some of the recommendations of this project successfully implemented. Now that the information has been gathered from other cities, the next step is to implement those recommendations in Columbus. Some questions include:

1. What are the next steps for the development of light rail? What organization will be in charge?
2. What incentive programs can be used to increase ridership?
3. How can the City of Columbus connect to the suburban areas?
4. What is the timeline for implementing light rail?

Overall, this project was an excellent opportunity to look into what Columbus could do to advance their transportation system.

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