Revitalizing Transportation in the Milwaukee Metropolitan Area

Strategies to Improve Transit Access

(Ride MCTS, n.d.)

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DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy at the University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

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HONOR PLEDGE

On my honor, as a student, I have neither given nor received unauthorized aid on this assignment.

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EXECUTIVE SUMMARY

Transportation provides important access to resources associated with economic mobility, benefitting Americans at both ends of the economic spectrum. Adequate access to transportation increases workforce access, quality of life, and economic activity. However, in the Milwaukee Metropolitan Area, low-income individuals do not have sufficient access to transportation.

Jobs, quality food, reasonably-priced goods, health care, and education exist in most areas, but without a means of access, individuals of all income levels cannot reap the corresponding benefits of these services. Studies show that low-income individuals have better access to jobs by car than by transit and transit connections. Despite this fact, those with the most to gain from public transportation options "are also the ones most likely to be excluded from them" due to a variety of barriers including cost, proximity, and hours of operation (Galvez, 2016).

This analysis discusses the nationwide problem of inadequate access to transportation, focusing specifically on solutions that could benefit the four-county Milwaukee Metropolitan Area. This report uses four (4) criteria — cost effectiveness, political feasibility, equity of scale, and compatibility & administrative feasibility — to analyze the projected outcomes of four (4) policy alternatives:

- Alternative 1: Status quo
- Alternative 2: Neighborhood mobility hubs
- Alternative 3: Local transportation management association (TMA)
- Alternative 4: Public-private partnership with Uber, Lyft, or other transportation network company (TNC)

A leading solution will generate gains in the primary outcome, passenger miles traveled (PMT), while increasing access for those who need it most. Ultimately, this report recommends Alternative 3, launching a TMA. This alternative is the most cost-effective option among those provided, generating a cost per PMT less than the status quo and broad benefits without geographic limitations within the region. This option fills existing transit gaps in the area by instituting flexible services, promoting an equitable transportation environment for Milwaukee-area residents.

GLOSSARY

AV — Autonomous Vehicle

FTA — Federal Transit Administration

HART — Hillsborough Area Regional Transit Authority (Tampa, FL)

MCTS — Milwaukee County Transit System

MPO — Metropolitan Planning Organization

PMT — Passenger Miles Traveled

PPP — Public-Private Partnership

PSTA — Pinellas Suncoast Transit Authority (Pinellas County, FL)

RTD — Regional Transportation District (Denver, CO)

SERTA — Southeastern Regional Transit Authority

SES — Socioeconomic Status

SEWRPC — Southeastern Wisconsin Regional Planning Commission

TNC — Transportation Network Company

VMT — Vehicle Miles Traveled

VRF — Vehicle Registration Fee

WisDOT — Wisconsin Department of Transportation

PROBLEM DEFINITION

Studies show that low-income individuals have better access to jobs by car than by transit and transit connections. By extension, this means public transit and other potentially cost-effective and financially accessible methods of transportation do not serve those who may need them most to access social and economic opportunities. This study aims to address the following problem definition: Low-income individuals do not have sufficient access to transportation in the Milwaukee, WI Metropolitan Area.

There exist notable costs to society from lack of access. Low-income individuals may possess the skills necessary for available jobs but may not be able to access them; therefore, a major negative externality of poor public transit is unemployment. The Milwaukee County Transit System (MCTS) reports that 41 percent of existing riders state their primary reason for using the system is to get to work (MCTS, 2016). With jobs increasingly sprawled throughout the metropolitan area, those without access to a vehicle — characterizing between 19 and 29 percent of Milwaukee-area households, depending on neighborhood — rely on transit to take part in interviews, job trainings, and ultimately, the workforce (Behm, 2017).

Further, inconvenience in accessing specific areas could lead jobseekers to engage in work they are not well-matched for; they might also accept jobs that pay less or offer fewer benefits resulting solely from inconsistent transit availability. However, the concept of adequate public transit does not only consider geographic reach, and also includes service availability (including hours of operation and frequency of service) and service cost. If public transit does not operate in accordance with a worker's job schedule or is too expensive, the service, even if the infrastructure is physically available, is not helpful to the individual.

In addition to lack of income, another cost of unemployment is decreased spending power for the greater economy, potentially resulting in decreased goods and services (Edgmand et al., 1996). Consumer spending, historically, has accounted for two-thirds of spending, and the economy needs employed individuals "in order for income to continue to grow. People need that income to be able to spend" (Dynan, 2011). Inadequate transit access makes it difficult to maintain employment and earn an income to spend. Additionally, poor transit access interferes with an individual's ability to reach lower cost goods and quality products (such as affordable healthy food) which has health- and quality-of-life-related implications.

Transportation is also important in enabling access to valuable health care services. The inability to find or afford a ride to care centers costs patients, caregivers, providers, insurers, and taxpayers — missed appointments and associated delays not only harm patients, but the system at large, costing the health care system an additional $150 billion annually (Cronk, 2016; Sviokla et al., 2010). Direct costs to patients (from lack of access) may include no-show expenses and negative effects on health from missed appointments, whether intentionally missed or unintentionally skipped due to incompatible or delayed transit schedules. A 1997 study of cancer

patients in Texas found that transportation issues led patients to forgo cancer treatments, a tendency especially common among minority respondents (Guidry et al., 1997). In a more recent study, Silver et al. (2012, as cited by Syed at al., 2013) surveyed 698 low-income patients in a New York City suburb and found that patients who took the bus to appointments were twice as likely to miss visits than those who drove. The clinical implications identified in these and other studies — including missed appointments and unfilled prescriptions — highlight the important role of transportation in health management. A lack of reliable transit "may lead to poorer [patient] management of chronic illness and thus poorer health outcomes" (Syed et al., 2013).

Non-economic costs associated with unemployment and poor transit access include unfavorable effects on mental and physical health, families, rates of alcoholism and drug abuse, and crime and suicide (Edgmand et al., 1996). With respect to health outcomes, unemployed individuals "tend to have higher levels of impaired mental health including depression, anxiety, and stress, as well as higher levels of mental health hospital admissions, chronic disease (cardiovascular disease, hypertension, and musculoskeletal disorders), and premature mortality" (Pharr et al., 2012). Some longitudinal studies have shown that higher levels of depression result from unemployment, showing that the two factors are more than correlated. In a 2012 study, Pharr et al. found that unemployed participants had significantly worse perceived mental health, were more likely to defer health services due to cost, and were less likely to have access to health and preventative care compared to employed and voluntarily out-of-the-labor force participants. Costs to society associated with social capital and isolation are detailed later in this report.

BACKGROUND

Critical Issues in Regional Transportation

Mass transportation and quality of life

Public transportation can greatly expand access to jobs and services key to economic mobility, benefitting Americans at both ends of the economic ladder. Mass transit is especially crucial for poor populations who cannot afford cars, yet in many cities, access to public transportation is often worst for the most impoverished (White, 2015).

Many studies connect geographic mobility and mass transit access to economic mobility. Access to numerous markers related to economic progress — including jobs, quality food, reasonably-priced goods, health care, and education — requires both the physical and financial ability to move from a point of origin to a destination. However, trends towards the increasing suburbanization of poor populations and of jobs can work against low-socioeconomic status (SES) groups when suburban areas do not effectively support their public transit needs (Zimmerman et al., 2015).

Necessary transportation infrastructure and related programs have not appropriately expanded to meet new, increasingly suburban needs. A 2011 Brookings Institution report found that a typical US metro area only reaches 30 percent of jobs in that metro area, which leaves a majority of workers left to find other means of accessing a nearby transit hub or otherwise make a full trip to a destination (Tomer et al., 2011).

Transportation enables access to key everyday resources, including employment. The existing mismatch between service availability and need, especially for low-income individuals, inhibits opportunities to physically mobilize and promote upward mobility. This study aims to address considerations relevant to the stated problem identification: Low-income individuals do not have sufficient access to transportation in the Milwaukee, WI Metropolitan Area.

National poverty trends: The suburbanization of poverty and jobs

In 2016, 12.7 percent of the US population lived in poverty (Semega et al., 2017). But while a second consecutive annual decline in poverty is promising, 40.6 million people remain in need. Further, according to the US Census Bureau, 18.5 million people — 45.6 percent of those in poverty — were living in deep poverty, a circumstance that disproportionately affects children under the age of 18 and black and Hispanic individuals ("What is 'deep poverty,'" 2018). In fact, many of those in deep poverty fell deeper into poverty, with the share of the US poor population reaching its highest point in at least 20 years (Bialik, 2017). Stark income inequality, however, is largely a modern trend — in 2010, the upper economic tier (defined as those in households

above 200 percent of the national median income threshold) held 46 percent of US aggregate household income, a sharp increase from 29 percent in 1970 (Pew Research Center, 2012).

Historically, poverty has occurred most in urban inner cities or rural communities (Kneebone, 2017). However, beginning in 2000, "the total number of poor people living in the suburbs exceeded those living in central cities in the 95 largest metropolitan areas," including the Milwaukee Metropolitan Area (Murphy & Allard, 2015; Suro et al., 2011). In 1980, poor blacks in Milwaukee were tightly clustered and poor whites were widely dispersed; today, poor blacks occupy a much larger geographic area when compared to 1980 (MacDonald & Turner, 2013). The rise of suburban poverty is not isolated to a particular region or part of the US, and more than two-thirds of poverty increases in major metro areas have occurred the suburbs. The suburbs accounted for 56 percent of poor populations in major metro areas by 2012; however, "importantly, the rise of suburban poverty has not corresponded with decreases in urban poverty," and poverty rates continue to remain higher in central cities and rural areas (Murphy & Allard, 2015).

Nationally, the suburbanization of jobs has highlighted the need for adequate suburban transit. Between 2000 and 2012, available jobs within a typical commute distance for residents of many metro areas fell by seven percent (Kneebone & Holmes, 2015). Further, despite the shift of poor and minority residents towards suburbs in the early 2000s, those individuals' proximity to jobs fell more than for non-poor and white residents in this period (Kneebone & Holmes, 2015). Ultimately, as people and jobs suburbanized in the 21st Century, the number of jobs near the average resident fell, further underlining the importance of transportation services.

Glaeser et al. (2006) argue that the poor have traditionally lived in urban centers because of public transportation. Automobile ownership is costly, and proximity to transit in city centers offers a more affordable option. The authors argue that public transit requires high-density areas, "so if inner cities have public transportation and suburbs do not, then this can explain the urbanization of the poor" (Glaeser et al., 2006). With employment opportunities increasingly in the suburbs, those without means of transport struggle to connect to opportunities. As discussed below, sprawling suburbs are not conducive to efficient public transportation networks. However, with the poor increasingly residing in suburbs, solutions to transit deficits are necessary to prevent social and economic isolation among less affluent groups.

Suburbs are now faced with traditionally-urban challenges, including poverty, joblessness, and decline. Transforming transportation is necessary in reducing the negative impacts of suburbanization.

Suburban public transit: Variable, and often inconsistent

Suburban areas lack sufficient and reliable public transportation. Large metropolitan areas with light rail capabilities face constraints in ways similar to midsize cities that rely solely on public

bus systems; difficulties balancing per capita demand and financial cost persist among cities of all sizes, regardless of the modes of public transit available.

Despite demand for better public transit, efforts to introduce or expand light rail systems have not yielded promising results. In Denver, despite a $4.7 billion initial investment, only six percent of people used Denver public transit as part of their commute to work in 2016, and between 2010 and 2015, Denver's Regional Transportation District (RTD) system's per capita boardings were down four percent, in line with national trends (Small, 2017). In the past five years, rail efforts in other cities have failed to pass altogether, signaling that rail transit may not be wanted, needed, or the financially responsible development choice, especially considering national trends towards increased vehicle miles traveled (VMT) and declines in ridership (Tolbert, 2014; Pascale & Skelton, 2016; Pascale, 2016; Small, 2017). Notably, 2016 data shows that while transit ridership generally decreased nationwide, cities that engaged in efforts to redesign bus networks — as opposed to focusing primarily on rail expansion — were able to resist the trend (Schmitt, 2017).

Budgetary issues contribute especially to bus service scrutiny. In Tampa, Hillsborough County's 2017 network restructure cut bus services by approximately 20 percent, decreasing the then-existing 41 routes to 34 (Irwin, 2017). The Hillsborough Area Regional Transit Authority (HART) is one of the nation's most underfunded transit agencies with per capita spending comparable to cities with populations of less than 50,000; by comparison, nearly 1.4 million call Hillsborough County home (Irwin, 2017). The service cuts largely affected areas outside of Tampa where transit ridership was lowest. Per the HART plan, the changes aimed to increase service and enable faster connections for 80 percent of riders. However, the remaining one-in-five riders were likely to not see benefits from the changes; additionally, according to officials, commutes for 10 percent of riders would instead be worse (Johnston, October 2017).

HART is not alone in its decision to cut bus services, nor is it alone in how its cuts affect riders; Chicago and other cities are similarly balancing the value of running empty buses, complaints of limited hours, and route cuts altogether (Wisniewski, 2017). Terminated services disproportionately affect vulnerable communities across diverse urban centers. Sixty percent of public transit riders identify as belonging to a community of color; additionally, while 13 percent of US households have incomes of less than $15,000, the percentage of transit-using households with the same level of income is 21 percent — eight percentage points higher than the general national average (Clark et al., 2017).

Cuts to bus routes have notable impacts on local economic development. Transit is an important and necessary means of connection that can drive workforce access — and, by extension, economic mobility. Eighty-seven percent of public transportation trips involve local economic impact, with purposes including getting to or from work, shopping, and recreational local spending (Clark et al., 2017). For communities concentrated in urban areas, transit provides a means of accessing suburban jobs; for the poor living in suburban areas already, transit offers an important means of connection to centralized hubs of economic activity and to other suburbs

where job opportunities and resources may exist. From multiple perspectives, effective public transportation offers a path for greater local economic impact.

Urban sprawl: The impacts of geography on mobility

Urban sprawl describes the rapid geographic expansion of cities and towns, often characterized by low-density housing, single-use zoning, and greater reliance on private automobiles for transportation (Rafferty, n.d.). Many are critical of urban sprawl, associating it with negative externalities including increased vehicle pollution and congestion, inner city decay, increased segregation of social classes, less social interaction, and higher rates of obesity (Brueckner, October 2000; Brueckner, April 2000; Nechyba & Walsh, 2004; Frumkin et al., 2004 as cited by Cowell, 2011).

Notably, the automobile-related effects of sprawl significantly impact public transit systems. Suburban areas, frequently characterized by sprawl, have been developed based on heavy car use; many American cities, when compared to their dense European counterparts, are newer and were built with the car in mind (Stromberg, 2015). For a number of reasons, US cities are more car-dependent than their European counterparts — for example, in the 1960s, many European cities began refocusing their policies to curb car use ahead of car dependence, whereas the US did not (Buehler, 2014).

While benefits to sprawl exist, the widespread nature of suburbs makes cost-efficient and fast transit difficult (Stromberg, 2015). Financially, sprawl makes rail and bus services costlier to serve the same number of people across a wider geographic area; additionally, curved roads and highways make it difficult to reach transit stations and other destinations on foot. Geographic spread also affects transit convenience, as far-reaching stops often see less frequent service due simply to the physical distance of a suburban stop from an urban center. These factors, among others, make suburban public transit services less desirable for those who own a vehicle or who can otherwise afford to avoid it, impacting ridership and program cost effectiveness in these areas. Because a majority of riders — 54 percent nationally — have ongoing access to a vehicle, service decreases or small inconveniences could greatly impact ridership and service to the system as a whole, posing problems for the remaining 46 percent of riders who do not have a vehicle and rely on public transportation daily (Clark et al., 2017).

Proximity to transportation is associated with economic growth (Reese & Ye, 2011). While opportunities for work do exist for low-SES families, sprawl may make it difficult to travel from poorer neighborhoods. Spatial mismatch theory describes the impact of the disparity between where low-income individuals live and where suitable job opportunities lie (Kain, 1992). Although the causal effects of spatial mismatch have been widely speculated, the theory's implication for those subject to sprawl remains important: poor or unreliable public transportation in suburban areas, for those who do not have other means of commuting, unequivocally affects whether an individual can hold a job.

Numerous studies point to metropolitan sprawl as a barrier to upward mobility. Chetty & Hendren (2015, as cited by Bouchard, 2015) identify commuting time as the strongest factor in the odds of escaping poverty; "the longer an average commute in a given county, the worse the chances of low-income families there moving up the ladder" (Bouchard, 2015). This transportation measure was found to be stronger than other traditional factors, such as crime, elementary school test scores, or the percentage of two-parent families in a community. Critics of this study, however, point to commute time as an invalid proxy for urban sprawl, arguing that some of the smallest geographic areas have the longest commute times due to congestion (Ewing et al., 2016).

A separate report from NYU came to a similar conclusion. Kaufman et al. (2015) assessed New York neighborhoods by accessibility to mass transit and jobs with a commute of one hour or less, revealing notable variation in transit access levels. They found that residents of areas with the highest accessibility favored transit or walking, while those with the fewest options were likely to commute by means of private vehicle. Notably, they found that residents with some, but insufficient access to transportation saw the highest rates of unemployment and lowest incomes. The commuters who lived just beyond a convenient transit network but lacked the financial ability to own a private vehicle stood to benefit most from transit improvements.

Findings from Ewing et al. (2016) similarly support the idea that sprawling metro areas can harm progress. The authors concluded that "upward mobility is significantly higher in compact than sprawling metropolitan areas/commuting zones" and attributed the direct effect of compactness to better job accessibility in those areas. They found that as geographic compactness doubles, the chance of upward mobility increases by approximately 41 percent. The compactness indices developed by Ewing et al. previously, in the early 2000s, have been widely applied in outcome-related research, largely in studies related to public health. The indices have since been refined but remain similar and consider elements of the built environment including development density, land use mix, population and employment centering, and street connectivity (Ewing et al., 2016).

The aforementioned effects of sprawl and transportation-related measures on economic success exemplify the importance of providing public transportation for impoverished workers. However, it is important to note that the standards used to measure the effects of transportation on poverty and mobility are indirect, as it is difficult to assign cause among the many and related markers of poverty. However, if commute time, convenience, and urban compactness have tangible and documented impacts on upward mobility, programs and policies regarding these concerns can act as a starting point for future efforts.

Transportation and economic opportunity: Connecting people to jobs and resources

Transportation serves a variety of purposes, from shopping and errands to social and recreational visits. Commuting to and from work is a more major source of transportation needs.

As previously discussed, the suburbanization of employment has resulted in jobs being located outside of compact, transit-friendly areas. The resulting effect has been less reliable or inadequate modes of transit that do not ensure timely arrivals and may lead to workplace absences. The ability to hold a job and earn an income depends on worker accountability, which cannot be guaranteed with unreliable transit.

The "last mile" is frequently cited as an obstacle to greater public transit use. The last mile problem refers to the transit gap between a bus or rail stop and a final destination. Especially in low-density areas, such as in suburbs, improving last mile strategies could increase transit ridership. Presently, few studies exist on the last mile problem in transit and possible measures for success. However, cities nationwide have implemented policies aimed to combat the last mile problem, including flexible transit, public-private partnerships with transportation network companies (TNCs) like Uber and Lyft, microtransit, and bike share systems.

While workers themselves suffer from lower productivity in the absence of reliable transit, employers similarly lose, posing a cost to society beyond the individual worker. Businesses may lose valuable employees due to commutes and quality of life concerns; business productivity may also decline from tardiness or absenteeism, having greater effects for the economy at-large. Additionally, businesses and the economy may suffer if a significant portion of the population is unemployed and cannot spend money to stimulate the economy.

Longer commute times — whether resulting from transit breakdowns or the geography of sprawl — can also hurt an individual's social capital through negative impacts on productivity, time spent with family, and ability to take extracurricular trips (Shepherd, 2017). Social capital refers to the "networks together with shared norms, values, and understandings that facilitate cooperation within or among groups," and encompasses some factors lost to commutes and wasted time from transit (Keely, 2015). The positive psychosocial effects of social cohesion from being part of a group can benefit mental health and anxiety (Dannenberg et al., 2011). Social capital generates behaviorally mediated mechanisms, such as the group enforcement of social norms. High social capital is also correlated with mortality — empirical evidence from Kawachi et al. (1997) showed that the states with highest social capital, as shown by measures of trust between citizens, exhibited the lowest age-adjusted mortality rates (Dannenberg et al., 2011). Additionally, the built environment can affect social capital, as sprawl is often related to characteristics of the built environment "that make interactions between neighbors less frequent and reliance on vehicles for transport almost unavoidable" (Dannenberg et al., 2011).

Poor transportation has societal impacts from the costs associated with weak health. Low social capital can have physical and mental health impacts — sprawling suburbs encourage more driving and less walking, and fewer social interactions contribute to mental isolation — and infrequent or unreliable transit may impact individuals' ability to access preventative care. Convenience is a factor important to daily functioning, and the inability to take care of oneself and build social capital can result in high spending on health care.

Effective public transit may serve as an indirect poverty-reduction method insofar that it enables economic activity. Poverty is a complex policy problem that cannot readily be solved through any single mechanism. Transportation improvements that focus on poverty reduction or on economic growth may have notable effects; however, the precise impacts of an improvement depend heavily on the project itself and the community the project will serve. Further, effects will be contingent on the private markets and government regulations that define the operating environment. Leading solutions will be friendly to locality-specific sprawl and the area conditions that drive economic activity.

Technology: Increasing trends towards digital platforms and autonomous vehicles

Advances in communications and vehicle technologies will impact — and to an extent, have already impacted — the transit landscape. Cars commonly include semi-autonomous features such as cruise control and parking assist, and TNCs rely on digital app interfaces to communicate with riders.

Although no longer novel, the societal transition to digital- and app-based platforms can pose challenges for low-income groups. From a financial perspective, smartphones and data packages are costly, and the assumption that all individuals use banks and credit cards cannot be overlooked. Future transit solutions to last mile problems must keep these considerations in mind and offer non-digital requirements or methods of access.

Additionally, fully autonomous vehicles (AVs) will transition transportation norms, even though there is little consensus on the net impacts of these vehicles. Advocates argue that driverless cars will make roads safer, improve traffic and fuel efficiency, improve land use, and reduce energy consumption and pollution, among other benefits (Thompson, 2016; “Self-Driving Vehicles,” 2014). Opponents believe that AVs could increase VMT, contribute to greater pollution, and shift resources away from traditional public transit. Despite speculation on both sides, however, industries and professions relating to health, land use, transit, technology, and policy will feel the effects of AVs, and sufficient preparation on the part of these industries will determine the eventual public impacts of driverless cars.

From an infrastructure perspective, Level 4 (fully autonomous) AVs, once widespread, will shift needs in the built environment. Efforts to mitigate and prevent greater urban sprawl will be necessary, in addition to physical changes in the built environment that accommodate decreased needs for parking and increased needs for drop-off and pick-up zones. From an employment perspective, AVs could eliminate driving-based occupations. However, “the extent to which AVs could eliminate certain occupations, resulting in job loss, while changing the mix of tasks involved in other occupations, is still not clear” (Beede et al., 2017).

Policy solutions that consider digital capabilities and the uncertainties related to AVs will likely see the most success. Online access can be a notable barrier to entry for some, and AVs will have

many effects on land use and urban design, liability, and transit demand management. Solutions that accommodate user needs and build in flexibility for an autonomous future may fare better in the long-run.

Best Practices

Recognizing the notable barriers posed by inconsistent and costly transit access, cities across the country have taken action to ease transit connections for their residents. The following strategies could be scaled for the Milwaukee Metropolitan Area, offering riders greater transit connectivity to employment and quality of life opportunities.

Transportation management associations (TMAs)

Transportation management associations (TMAs) nationwide aim to improve access to transportation and increase transit efficiency. TMAs are formal organizations of private sector businesses and public sector local governments. TMAs often give businesses a chance to advocate enhanced mobility and reduce individual employer costs associated with worksite transportation programs (NCTCOG, n.d.). Currently, the Milwaukee Metropolitan Area does not have a TMA or similar public-private sector coordinating body. Programs operated by individual companies may not exist currently due to lacking incentives to organize these types of services, in addition to not wanting to front all related costs. As organizing bodies that manage transit services and related logistics across multiple groups, TMAs can address these concerns, reducing per-employer costs and easing coordination-based barriers.

TMA funding typically comes from employer membership, but grant funding is also used. TMA budgets vary dramatically depending on location and degree of transit service operation (Texas A&M Transportation Institute, n.d.). A board of members usually directs the organization, which is served by a small professional staff (three or fewer) and volunteers to extend impact.

In addition to easing public-private relationships, TMAs often develop, fund, and launch services tailored to local needs such as flexible carpool or vanpool programs. Some TMAs also focus on improving congestion and air quality throughout a region. In Colorado, the Denver South Transportation Management Association (DSTMA) was a key partner in the Lone Tree Link shuttle program — a public-private fixed shuttle program involving three major employers and the local government, in addition to the DSTMA — and has partnered with other key pilot programs in the area. DSTMA is one of at least six major TMAs in the Denver region. RTD contributes some funding to TMAs, including the DSTMA, and offers them incentives to form vanpool programs.

Public-private partnerships with TNCs

A TNC — commonly known as a ride-hailing service — is a commercial organization that "provides prearranged rides for compensation using a digital platform that connects passengers

with drivers using a personal vehicle" (Virginia Department of Motor Vehicles, n.d.). Increasingly, public transit organizations are partnering with private TNC companies, recognizing the role rideshare can play in easing transit connections. Rideshare as a last mile solution is best served by geographically compact areas, but simultaneously offers promise in its on-demand ability to address gaps due to geography and transit schedules.

In East Lake, Florida (Pinellas County), the Direct Connect public-private program allowed the Pinellas Suncoast Transit Authority (PSTA) to discontinue a bus route with high per capita costs and instead subsidize TNC and taxi rides. PSTA expanded the service from its original temporary status to be county-wide after the pilot's initial success (Johnston, January 2017). In the pilot stage, PSTA discontinued a route that cost the organization $16 per rider and offered riders discounted Uber, Lyft, or cab rides from anywhere in the county to the nearest bus stop for $1 (PSTA contributed $5 per passenger to the program) (Grabar, 2016). Riders previously paid $2.25 per ride. In the county-wide expansion, PSTA allocated $100,000 for the first six months of the service — a figure significantly less than the $150,000 it would have cost to run the original East Lake connector plus the cost of the bus (Johnston, January 2017).

Public transit effectiveness: Measurements and metrics

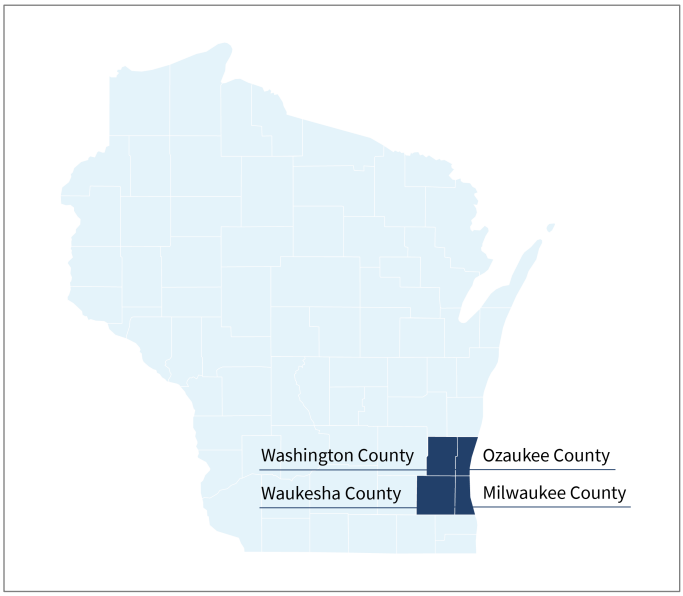
A variety of metrics can be used to assess the effectiveness of transit services. As described previously, certain measures — including commute time, as cited by Chetty & Hendren (2015, as cited by Bouchard, 2015) — do not effectively quantify the geographic circumstances that affect physical mobility; while overall commute time is related to distance traveled, certain metropolitan areas see more traffic congestion and service outages than others.

Passenger miles traveled (PMT) represents "the cumulative sum of the distances ridden by each passenger" ("NTD Glossary," 2018). PMT offers some indication of rider frequency, but more importantly, geographic distance covered. Contrasting ridership figures — which give insight into the number of passengers that use a public transit system — PMT numbers reveal trip distances. In the case of low-income access to public transportation and job access, while increases in ridership may be telling of general access to a system, PMT is a better metric when a primary outcome is to connect spatially mismatched workers and jobs. Ridership trends, while an effective complementary measure, would not evaluate this outcome as well, as it is subject to cultural tendencies to use public transit, time of year, and other leisure-related factors.

Still, despite the variety of transportation measures available, effects on economic mobility resulting from transit-related interventions are difficult to assess. While Gini coefficients provide

insight on income inequality, there is no metric that directly and jointly measures the impact of distance from a transit station on economic status. Factors other than physical job accessibility contribute to success in the workplace; unemployment figures do not result solely from employer-resident mismatch. However, correlational variables — such as commute time, urban compactness, and personal circumstances — remain relevant considerations for policymakers to take into account when developing programs.

Figure 1: Milwaukee Metropolitan Area
(Metropolitan Milwaukee Association of Commerce, 2014)



Regional Profile: Milwaukee, WI

Demographic trends

The City of Milwaukee, WI, located in Milwaukee County, is home to 595,047 residents. The US Census Bureau defines the Milwaukee Metropolitan Area, shown in Figure 1, as encompassing Milwaukee, Waukesha, Washington, and Ozaukee counties. In 2013, Metropolitan Milwaukee housed 1,569,659 residents (Metropolitan Milwaukee Association of Commerce, 2014).

Milwaukee is the sixth most impoverished city in the US and the most impoverished city in the state, with a poverty rate of 28.4 percent (Sauter et al., 2017; U.S. Census Bureau). In 2015, 36.5 percent of residents had incomes under $25,000 (Kennedy, 2015). With an overall walk score of 62 and a transit score of 49, Milwaukee is considered somewhat walkable and has some transit ("Milwaukee Apartments for Rent," n.d.). Neighborhoods within Milwaukee have scores both higher and lower than the city average.

Following national trends, Milwaukee has faced changes in employment and the geographic concentration of jobs over the years. Levine (2007) identified three main factors in the crisis of black male joblessness in Milwaukee: deindustrialization, the suburbanization of jobs, and racial segregation. Post-1970s, due to industrial decline, black males saw diminished job opportunities in the city. Since 1980, net job growth in the metro Milwaukee area has occurred in the suburbs, and at the time of the report's publishing (2007), the city had lost nearly 18 percent of its job base since 1980. Finally, spatial mismatch between the region's workers and jobs severely limited employment for black males; "the overwhelming majority (92 percent) of the region's working-age black males [lived] in a city with an eroding employment base, while all of the net job growth in the region [was] occurring in exurban areas where few blacks [lived] and to which city-based minority workers [had] minimal transportation access" (Levine, 2007).

The Milwaukee-based Public Policy Forum found that 19 percent of households in the city do not have access to a car, and that this figure increases sharply to 29 percent in some high-unemployment neighborhoods (Behm, 2017). The organization's report also identified "a higher [job] turnover rate for residents who rely on public transit and must cover the final distance to their job on their own to commute to the suburbs than those with a personal vehicle" (Terrell, 2017). The last mile is a major barrier to filling job openings in the Milwaukee area.

Transit in Metropolitan Milwaukee

Transit options in Milwaukee include public buses operated by MCTS, taxi and shuttle services, rideshare, Bublr bikes — Milwaukee's bike share program — and a trolley loop that operates during the summer months (Transportation, n.d.). While MCTS was recently ranked 13th in providing access to jobs, the last mile continues to pose difficulties for many workers, and it is not cost effective for MCTS to extend bus routes specific to employers (Fidlin, 2017). In attempts to alleviate transit gaps, MCTS currently offers three shuttle routes that drive through business or industrial parks at certain times during the day (Behm, 2017). However, the combination of low ridership and high per capita costs makes the future of these shuttles uncertain — "the MCTS cost per passenger averages $4 on its 60 routes, while the cost per passenger on the three shuttles averages between $14 and $20" (Behm, 2017). This suggests that dedicating more resources to niche shuttle lines is not a promising option.

In 2017, MCTS had an operating budget of $153.9 million and total expenditures of $160.5 million (Milwaukee County Department of Transportation, n.d.). For 2018, operation costs constitute $153.3 million of the $159.5 million allocated for total expenditures. Budget variance between 2017 and 2018 is as follows: $558,768 less in 2018 for operation costs, and just over $1 million less for total expenditures.

Services in 2018 will be similar to 2017 offerings; fixed-route service levels will change less than one percent from 2017 levels (Milwaukee County Department of Transportation, n.d.). However, this year, MCTS will assess a multi-year route redesign intended to identify areas of low ridership and reallocate bus hours from low-performing routes to corridors with greater demand, as MCTS passengers per bus hour is lower than the national average (Milwaukee County Department of Transportation, n.d.). The redesign aims to increase the proportion of frequent services from 40 percent to 60 percent. Additionally, MCTS has increased passenger fare to offset revenue losses from decreased ridership.

In 2016, 44 percent of the MCTS budget came from state funds, 25 percent came from passenger fare and other revenue ("farebox" revenue), 19 percent came from federal funds, and 12 percent came from local funds (MCTS, 2016). MCTS receives some federal funding from the Federal Transit Administration (FTA) for both fixed and paratransit services through the Fixing America's Surface Transportation (FAST) Act ("FAST Act," 2017). The FAST Act was reauthorized in 2015 through FY 2020 and provides five years of steady and predictable funding (FTA, 2016).

The state of Wisconsin receives transit aid from a number of federal programs, with the largest portion coming through the federal urbanized area formula and rural area formula programs (Wilson-Tepeli, 2017). Transit aid comes from the mass transit account of the highway trust fund. Some programs provide periodic funding through Congressional earmarks and discretionary awards, while others dispense aid annually based on a formula. In FY 2016, the federal government distributed $65.1 million in urbanized and nonurbanized area transit funds to the state; $20.1 million went directly to the Milwaukee Urbanized Area.

Despite decreasing farebox revenue and increasing operational costs, federal and state funding remains relatively flat, putting pressure on local funding streams (such as farebox revenue). A $30 per vehicle County Vehicle Registration Fee (VRF) provides dedicated local revenue (Fox6 News, 2016).

The Milwaukee Metropolitan Area is served by the Southeastern Wisconsin Regional Planning Commission (SEWRPC). SEWRPC also serves Kenosha, Racine, and Walworth counties. The Commission provides basic information and planning services to solve problems of regional consequence. SEWRPC works with the Wisconsin Department of Transportation (WisDOT), transit operators, and county and local governments, and is the federally recognized metropolitan planning organization (MPO) for the Southeastern Wisconsin region.

There is no regional transit authority for the greater Milwaukee area. For two years starting in 2009, the Southeastern Regional Transit Authority (SERTA) served as the area's cross-county transit authority with the purpose of bringing commuter rail to the Kenosha-Racine-Milwaukee corridor. However, in June 2011, the Republican-controlled state legislature and the Governor repealed the law creating SERTA and eliminated funding (SEWRPC, n.d.; Kenosha News Staff, 2018). Recently, Democratic state legislators introduced a bill to authorize a new regional transit authority (RTA) that, if approved, would "oversee transit services in Kenosha, Racine and Milwaukee counties. It could also acquire property, issue bonds or implement a half percent sales tax increase in the area to fund public transportation efforts" (Kenosha News Staff, 2018). Some peer localities, such as Detroit, have successful models of regional transit governance, suggesting that Metropolitan Milwaukee could benefit from implementing regional governance for transportation. However, the Republican-controlled Wisconsin legislature poses a notable political challenge to establishing new regional transit governance. State Republicans have already voiced concerns about authorizing an unelected taxing authority and will likely oppose such legislation or similar ideas (Kenosha News Staff, 2018).

Employment opportunities

The Milwaukee Metropolitan Area has a number of large employment centers and notable employment potential. A 2013 analysis by the Public Policy Forum identified 29 zip codes in the four-county region that contained at least 10,000 jobs at the time ("job centers"), including 11 job

centers in the region outside of Milwaukee County (but within the metropolitan area). However, inconsistent public transit reach to the identified job centers created potential problems for those without access to personal vehicles. While Milwaukee County job centers were largely found to be well-served by MCTS, outside of Milwaukee County, "only job centers in Brookfield (in Waukesha County) and Mequon (in Ozaukee County) [were] served by MCTS bus services, while the city of Waukesha [was] accessible with a connection between MCTS and Waukesha Metro Transit bus routes" (Peterangelo et al., 2013). Of the 29 job centers in Metropolitan Milwaukee at the time, the report identified 15 as having relatively high transit access, four as completely inaccessible by transit, and 10 as connected by transit on a limited basis.

POLICY ALTERNATIVES

Four (4) policy alternatives are considered in this report: (1) maintain the status quo, (2) establish neighborhood mobility hubs, (3) launch a TMA, and (4) develop a public-private TNC partnership.

Alternative 1: Status quo

Transit options in Milwaukee include public buses operated by MCTS, taxi and shuttle services, rideshare — including both Uber and Lyft — Bublr Bikes (bike share), and a trolley that operates during the summer.

Milwaukee ranks reasonably high when it comes to job access — 13th — offering the aforementioned wide range of transit options. In addition, MCTS offers three shuttle routes that serve businesses and industrial parks at certain times during the day (routes 219, 223, and 276). Milwaukee's transit system is also relatively integrated at this point in time, due in large part to an ongoing partnership between MCTS and Bublr in addition to the existence of a well-used mobility hub, the Milwaukee Intermodal Station. MCTS serves Milwaukee, Ozaukee, Washington, and Waukesha counties. Bublr primarily serves Milwaukee County, and has stations in Milwaukee, Shorewood, Wauwatosa, and West Allis.

Alternative 2: Neighborhood mobility hubs

A mobility hub combines multiple transportation services near or at a transit station to integrate mobility systems. Milwaukee currently has one major mobility hub, the Intermodal Station. The Intermodal Station offers access to Amtrak, intercity bus services, MCTS routes 12 and 57, Bublr bikes, bike parking, and Zipcar. According to WisDOT, "the Milwaukee Intermodal Station serves as the 'gateway' to downtown Milwaukee" and serves more than 1.3 million passengers per year making a variety of transit connections (Wisconsin DOT, n.d.). The facility also includes food services, ATMs, free Wi-Fi, and drop-off lanes at the front of the building. A main purpose of this increasing trend is to support last mile solutions.

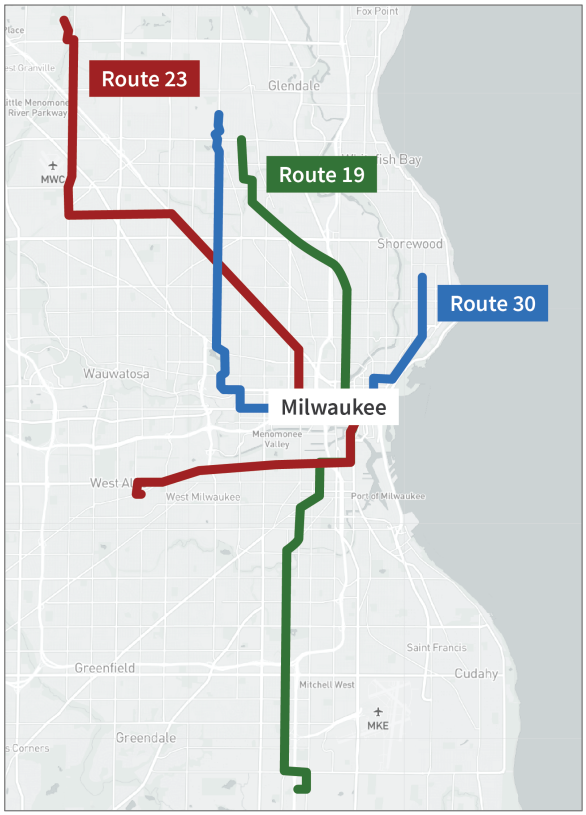
This option involves the city investing in small-scale mobility hubs in sprawling areas. Neighborhood mobility hubs established in lower income areas would bring better and more consistent transit to low-SES groups, as well as the resources to enable efficient transit use. These hubs would offer users greater access to last mile solutions. This option proposes piloting two (2) neighborhood mobility hubs on an existing MCTS route between geographically distant suburban stops. Areas ideal for these hubs would be those with access to far-reaching MCTS

lines and with high proximity to poverty and jobs. Possible areas of implementation, as shown in Figure 2, include suburban access points to routes 19, 23, and 30.[1]

This option would not involve greater investment in buses, nor would it require significant deviation from existing MCTS time and cost schedules. Each hub would include: a bus lane; Bublr bike share and personal bike parking; a car pick-up and drop-off zone; wayfinding and real-time information; and a sheltered waiting area.

One long-term benefit of mobility hubs is the inherent flexibility associated with these stations; mobility hubs are designed such that they can accommodate possible future growth as the market changes and new technologies evolve. As AV technology accelerates, flexible mobility hubs may make the integration of these vehicles less disruptive.

Figure 2: Possible MCTS routes for hub implementation
(MCTS Map for UVA, 2018)



Alternative 3: Local transportation management association (TMA)

This option would involve forming a non-profit TMA with members from both the private sector and the public sector. Urban business improvement districts, chambers of commerce (such as the Metropolitan Milwaukee Association of Commerce), or local governments typically lead TMA formation (Texas A&M Transportation Institute, n.d.). Potential members include:

- Private sector organizations with more than 5,000 local employees (Metropolitan Milwaukee Association of Commerce, n.d.):
    - Aurora Health Care (Milwaukee County, 22,000 local employees)
    - Wheaton Franciscan Healthcare (Milwaukee County, 12,000 local employees)
    - Froedtert & Community Health (Milwaukee County, 8,900 local employees)
    - Roundy's (Milwaukee County, 8,400 local employees)
    - Kohl's Corp. (Waukesha County, 7,800 local employees)
    - GE Healthcare Technologies (Waukesha County, 6,000 local employees)

[1] Within 0.25 mile of stops, route 19 (M. L. King – S. 13th & S. 20th) has 67,850 jobs, 34.1 percent in poverty, and 21.4 percent without vehicles; route 23 (Fond du Lac – National) has 69,255 jobs, 34.7 percent in poverty, and 22.7 percent without vehicles; and route 30 (Sherman – Wisconsin) has 80,370 jobs, 32.8 percent in poverty, and 25.0 percent without vehicles (MCTS Map for UVA, 2018).

    - Quad/Graphics, Inc. (Waukesha County, 5,600 local employees)
    - Medical College of WI (Milwaukee County, 5,400 local employees)
    - Northwestern Mutual (Milwaukee County, 5,000 local employees)
- Public sector organizations associated with potential private sector members:
    - City of Milwaukee (including Mayor and Council Members)
    - County of Milwaukee
    - City of Waukesha (including Mayor and Council Members)
    - Waukesha County (including County Cooperation Council members, who come from the county's 37 municipalities)
    - Southeastern Wisconsin Regional Planning Commission (SEWRPC)
    - Milwaukee 7 Regional Economic Development Partnership (Milwaukee 7)

The primary beneficiaries of this alternative would be the employees or affiliates of member organizations. Should the TMA have members interested in regional planning and development — or have public sector organizations dedicated to public use of TMA resources — the pool of possible beneficiaries could grow. However, within the designated 9-year scope of this analysis, public expansion is unlikely to occur.

In Year 2, after the TMA is established, this alternative would also involve implementing a carpool incentives program wherein the TMA would subsidize the gas of carpooling employees. This program would be one of the first programs offered by the organization (as opposed to a program that would require capital investment, such as a vanpool program).

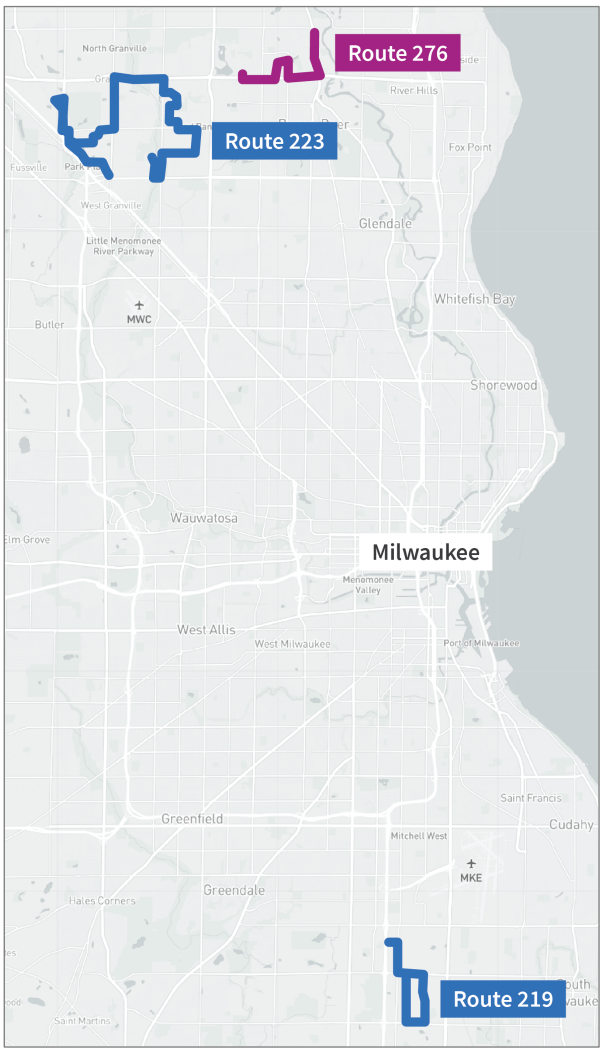
A TMA would allow organizations in the Milwaukee Metropolitan Area to pool their resources to support their workers. This option specifically advocates for the establishment of a TMA organization and a carpool incentives program in Year 2 but recognizes that the existence of a TMA in the area would have broader positive effects on mobility. A TMA would be able to advocate for and establish niche services with high local impact at any point after organization formation, and a carpool incentives program is only one of many mobility solutions a Milwaukee-area TMA could sponsor. Further, this organization would also be able to react quickly to changes in the transportation landscape — such as MCTS service cuts or the introduction of AVs — and help mitigate disruption.

Alternative 4: Public-private partnership with Uber, Lyft, or other TNC

TNCs offer flexibility and are responsive to demand. Rideshare services can complement traditional public transit options by providing a point-to-point last mile strategy. This option involves launching a public-private partnership (PPP) to reduce rideshare costs for transit riders, particularly low-income transit riders. Both Uber and Lyft operate in the Milwaukee area. Discounted rates would only be available to those engaging with public transit.

As shown in Figure 3, this option proposes replacing MCTS routes 219, 223, and 276 — the routes that serve business parks in Brown Deer, Menomonee Falls, and Oak Tree — with a pilot TNC partnership program like the Pinellas County Direct Connect program. Existing shuttles are operated such that they match shift change times, and service availability declines significantly at other points during the day; the area therefore could benefit from a more flexible and cost-efficient system (Peterangelo, 2017). Should the program see success, MCTS could expand the PPP to other employer and job sites. Because there is known demand for MCTS transit services in locations along the three shuttle routes, the area would be a good testing ground for such a pilot program in terms of future assessment and evaluation. This geographic area would additionally be a logical testing ground for this type of program because County leadership has already considered eliminating the three routes due to budget constraints in the past (Behm, January 31 2018).

Figure 3: Routes for replacement under Alternative 4
(MCTS Map for UVA, 2018)



Notably, rideshare may be prohibitive for low-income individuals. First, because rideshare costs are typically based on demand, the lack of consistent fares poses challenges for individuals tied to a tight budget. This alternative proposes implementing a flat-rate fare model to provide consistency and alleviate individual budgeting concerns. Second, as rideshare vehicles are traditionally hailed through mobile apps, low-income individuals without access to a smartphone are placed at an extreme disadvantage and may not be able to access rideshare platforms entirely. This PPP would include traditional cab services in addition to app-based TNCs, easing concerns related to technology access. The inclusion of cab services also would allow for cash payments — a feature not found in TNC digital apps.

Importantly, TNCs are actively experimenting with autonomous technology. Given the trajectory of AVs, a partnership with private companies on the forefront of AV technology could greatly benefit the area and help to better incorporate AVs once publicly launched.

EVALUATIVE CRITERIA

The aforementioned policy alternatives will be evaluated according to four (4) criteria: (1) cost effectiveness, (2) political feasibility, (3) equity of scale, and (4) compatibility & administrative feasibility. Cost effectiveness is a quantitative, outcome-oriented criterion, whereas political feasibility, equity of scale, and compatibility & administrative feasibility are assessed qualitatively. The criteria detailed below create a holistic framework that evaluates the general strengths and weaknesses of each policy alternative over a period of nine (9) years.

Criterion 1: Cost effectiveness (weighted at 55 percent)

The cost effectiveness criterion measures PMT per dollar spent. PMT refers to the sum of distances ridden by each passenger (Federal Transit Administration, 2015). Cost effectiveness is calculated by dividing PMT by a program's total cost, identifying the number of PMT per dollar. By this criterion, the best option will yield the most PMT for the lowest total cost.

This criterion is weighted the highest due to recent MCTS budget cuts ($882,586 in the system's 2018 budget approved by the County Board) and the demonstrated relevance of cost-effective programs (Behm, January 15 2018). The analysis has been discounted and conducted in terms of real 2018 dollars ($), and considers estimated costs associated with implementation, program operation, and time traveled.

Criterion 2: Political feasibility (weighted at 20 percent)

Political feasibility refers to the political acceptability of an alternative. This criterion considers level of political support and opposition towards the alternative (for example, too much opposition and/or too little support, or vice versa). Political feasibility is weighted at 20 percent due to the importance of this criterion in whether a policy alternative can pass.

For the purposes of this report, political feasibility is assessed qualitatively on a three-step scale of low to high, with low representing low predicted buy-in and high representing high predicted buy-in. This criterion considers support from different groups including decision makers, the public, and other key stakeholders.

Criterion 3: Equity of scale (weighted at 15 percent)

Equity of scale measures the extent to which the alternative supports widely dispersed populations versus concentrated populations. This criterion gives specific consideration to an alternative's effects on low-income households. Low-income is defined as those below the federal poverty threshold (AAA Newsroom, 2017).

Equity of scale is measured qualitatively on a three-step scale of low to high, with low representing concentrated effects and high representing widely dispersed effects. This criterion also considers barriers that would impact whether a user would choose to use a given transit method, such as transfer difficulties, cost, and geographic access.

Criterion 4: Compatibility & administrative feasibility (weighted at 10 percent)

Compatibility refers to the ability of an alternative to integrate with existing services and development plans. Program compatibility is important to consider because incompatible alternatives might instead increase costs beyond those projected in this analysis. Poor compatibility might also cause an alternative to be less effective. Administrative feasibility refers to a program's ability to roll-out effectively. Factors including number of individuals or organizations involved in the implementation process and timeline are considered, among others.

This criterion is measured qualitatively on a three-step scale of low to high, with low representing low predicted compatibility & administrative feasibility and high representing high predicted compatibility & administrative feasibility. In terms of compatibility, this criterion primarily considers how an alternative would affect MCTS. The administrative feasibility component of this criterion considers the number of individuals potentially involved in implementation, timeline of implementation, and complexity of program.

EVALUATION OF POLICY ALTERNATIVES

For each alternative, the following analysis provides an estimate for cost effectiveness and an ordinal ranking each for political feasibility, equity of scale, and compatibility & administrative feasibility. Cost effectiveness is evaluated in real 2018 dollars ($). The qualitative criteria are each assigned an ordinal ranking of low, medium, or high. The geographic scope of the analysis is the Milwaukee Metropolitan Area, encompassing Milwaukee, Waukesha, Washington, and Ozaukee counties. The timeframe of analysis is nine (9) years.

Criterion 1: Cost effectiveness (weighted at 55 percent)

Based on net present value estimates of total program cost and PMT, Alternative 3 proved most cost effective. At $1.03 per PMT, Alternative 3 would cost nearly one-third less than Alternative 1 or Alternative 2 ($1.53 per PMT each) and would be significantly less expensive than Alternative 4 ($1.60 per PMT). Appendix A provides a detailed cost breakdown for each alternative.

Alternative 3 would not face the substantial building or investment costs of Alternative 2, nor would it face the high annual human capital and vehicle operation costs of Alternative 4. While Alternative 3 would be costly, it would have a wide base of potential beneficiaries, yielding the lowest cost per PMT.[2]

Alternative 2 would be the least costly option over the status quo but would serve a geographically concentrated and relatively smaller base of potential beneficiaries. Alternative 4 would replace existing bus lines, resulting in a transfer of PMT from MCTS to the PPP, rather than a gain. For the high price and little guarantee of PMT gain, Alternative 4 would be the least cost-effective choice.

Criterion 2: Political feasibility (weighted at 20 percent)

Alternative 1 received the highest political feasibility score, a ranking of high, due to the absence of policy change; maintaining the status quo would require little to no political capital from decision makers (such as members of the Milwaukee County Board of Supervisors, whose decisions affect funding) and other key stakeholders. Alternative 3 also received a score of high due to the relative ease of creating a non-profit. However, establishing the correct scope and authority for the organization would require both monetary and time investments from leaders across both the private and public sectors, contributing to this alternative's political difficulty.

Alternative 2 received a ranking of medium for this criterion. Because mobility hub development is not a widely known transit solution, Alternative 2 would draw little controversy. Those in the immediate vicinity of a hub would benefit from the additional resources and would likely support

[2] The projected total cost (above Alternative 1, the status quo) of each alternative is as follows: Alternative 2, $519,781; Alternative 3, $13,442,998.11; and Alternative 4, $85,397,701.

the investment; however, because this alternative would produce concentrated benefits, others throughout the region might oppose spending for this alternative. Alternative 2 would also be the costliest option in regards to PMT gained from a given option ($0.10 per PMT gained versus $0.02 or less per PMT gained for the other alternatives), which further hurts this option's political feasibility ranking.

Alternative 4 also received a political feasibility ranking of medium. While a PPP would significantly decrease per capita transit spending in the designated geographic area, it would generate significant costs above the status quo that do not prove cost effective overall, decreasing the appeal of this option. However, Alternative 4 would introduce both geographic and operating flexibility not presently available, suggesting potential riders and their representatives might support this alternative. Further, PPPs have proven successful and effective in other areas, which would decrease the risks associated with investing in this option.

Criterion 3: Equity of scale (weighted at 15 percent)

Alternative 3 received a ranking of high for equity of scale, which measures both equity of access between low-income groups and high-income groups and degree of the option's geographic reach. Once established, a TMA would, at minimum, offer transit benefits to all affiliates of member organizations. Dependent upon the types of programs implemented by the TMA, this alternative would offer widely dispersed geographic transit access. The first program offering, as proposed in the alternative and starting in Year 2, is a carpool subsidy program that would not have geographic or income limitations; for individuals seeking to participate in the program without vehicle access, the program would create opportunities and incentives for existing drivers to share their resources. Additionally, based on efforts by existing TMAs, it would be likely that a TMA in this region would eventually serve workers and individuals beyond member organizations. In regards to benefits for low-income individuals, this option would generate neutral to positive effects, dependent upon if organizations with many low-income workers were to become members of the TMA.

Alternative 4 received a medium ranking for this criterion. At least initially, the PPP would only replace specific existing MCTS routes, resulting in limited geographic reach. This option would have neutral effects on access for low-income groups, as those that previously traveled using the MCTS routes would transition to using the PPP; the population using the PPP would mirror that of current route 219, 223, and 276 users. Additionally, this alternative did not earn a higher score due to the potential for technology-related issues in access for low-income individuals. Although the option dictates flat fares and opportunities for cash payments to alleviate this drawback, these strategies would not ease challenges for every rider. Alternative 4, however, earned a higher score than Alternative 2 — which earned a ranking of low — because of the door-to-door nature of TNC services; mobility hubs would be geographically-fixed investments, requiring users to reside or work within a reasonable distance from the hub in order to see benefits. The effects of Alternative 2 for low-SES populations would depend entirely on hub placement.

Alternative 1 also earned a ranking of low. Although the Milwaukee region has received reasonable rankings in terms of connecting residents to jobs, low-income individuals, who may live far distances from their places of work, may spend more time commuting and may make overall more transfers than their high-SES counterparts. This alternative does little to alleviate disparities in commute difficulty among diverse income and geographic conditions.

Criterion 4: Compatibility & administrative feasibility (weighted at 10 percent)

Alternative 1 received a ranking of high in compatibility & administrative feasibility due to ease of implementation — the status quo condition would not make any administrative or operational changes to existing MCTS offerings.

Alternative 4 also received a high ranking under this criterion, as a PPP would split the burdens associated with operating a new program among multiple entities. However, a new program, especially one involving multiple stakeholders, would require more coordination than presently exists (namely between the TNC, MCTS, and affected metropolitan area counties). Alternative 4 would likely be compatible with MCTS, as it would be designed to facilitate system use in an area with known demand; however, notably, due to the potential for market disruption, perfect compatibility would not be guaranteed as some studies have shown that TNCs draw individuals away from public transit and have inadvertently added to traffic and congestion (Badger, 2017).

Alternatives 2 and 3 received lower scores for this criterion. Alternative 3 fared the worst — receiving a ranking of low — due largely to the high number of key stakeholders required to establish a partnership non-profit organization; assembling a large association to jumpstart other forms of organized transit (beyond the current status quo) would require cooperation from the leadership of large area employers, as well as government officials from affected counties in order to maximize impact. Launching and managing a non-profit also would require significant effort and investment. Further, there would be no guarantee that programs put forth by the TMA would support MCTS; TMA services could instead take away from public transit ridership by offering incentives to travel by other means.

Creating mobility hubs, as outlined by Alternative 2, would be compatible with MCTS, as the option uses existing MCTS routes as the base condition for new features and greater innovation. However, the new features would necessitate greater regular maintenance in addition to coordination with third-party mobility organizations such as Bublr, earning this option a ranking of medium.

OUTCOMES MATRIX

The analysis produces the following comparative matrix, with Alternative 3 performing best in the holistic analysis.

Table 1: Outcomes Matrix				
	Status Quo (1)	Hubs (2)	TMA (3)	PPP (4)
Cost Effectiveness (weighted at 55 percent)	$1.53	$1.53	$1.03	$1.60
Political Feasibility (weighted at 20 percent)	High	Medium	High	Medium
Equity of Scale (weighted at 15 percent)	Low	Low	High	Medium
Compatibility & Admin. Feasibility (weighted at 10 percent)	High	Medium	Low	High

RECOMMENDATION & IMPLEMENTATION

Based on the outcomes matrix presented above, this analysis recommends pursuing Alternative 3, creating a non-profit transportation management association (TMA) for the Milwaukee Metropolitan Area. A Milwaukee-area TMA will promote coordination between the private and public sectors, creating a means to facilitate collaboration on transportation issues for years to come.

Forming a TMA for the region is the most cost-effective choice among the options proposed, yielding the lowest cost per outcome measure, passenger miles traveled (PMT). Given the importance of program cost in feasibility and implementation, a recommended policy alternative should produce cost-effective and wide benefits; establishing a TMA satisfies both conditions.

This alternative is also the most equitable choice in terms of both equity of access to transit systems between low-income groups and their high-SES counterparts, as well as degree of geographic reach. Both socioeconomic and geographic equity matter for solutions that aim to increase transportation access among low-SES groups in order to be effective in practice.

Forming a TMA is also the most politically feasible option after Alternative 1, the status quo, as creating a non-profit requires little, if any, political capital. Notably, the recommended option received the lowest score for compatibility & administrative feasibility. However, compatibility & administrative feasibility — which considers factors including number of individuals involved in implementing the strategy, timeline of implementation, and complexity of program — is weighted the least in this analysis, and while important, is not a top priority.

Forming a TMA, when compared to the other options, is the most well-rounded choice for a number of reasons. After established, the TMA could implement any number of programs designed to facilitate greater transit access for all populations, low-income or otherwise. The inherent flexibility of this alternative is a major pro for this option; in the long-run, establishing a non-profit authority — with power limited to offering services and that operates largely on member contributions — creates a low-risk and low-cost vehicle for future transit solutions. For example, the gas subsidy program, proposed as part of this option, aims to incentivize carpooling generally; however, it simultaneously creates opportunities for those without vehicles — whether by personal choice or due to financial constraints — to access to a new form of mobility not previously available to them.

Sensitivity analysis of Alternative 3

The author conducted a sensitivity analysis of the recommended option that yielded the effects shown in Appendix B. Holding all else constant, three separate analyses were conducted: Sensitivity 1 assumed half the number of possible benefitting passengers of the original analysis

(5,940 versus 11,880), Sensitivity 2 assumed double the number of additional commute hours per person (19.8 hours versus 9.9 hours for 11,880 individuals), and Sensitivity 3 assumed the TMA would not be operational until Year 3 (versus Year 2, as stated in the option), delaying the potential for PMT gains by one year. Each cost analysis of the recommended option yielded a total cost per PMT lower than the status quo condition, further supporting the stated recommendation with regards to cost efficiency.

Implementation & conclusion

The largest barrier to success when creating a TMA will be administrative feasibility — launching the TMA and later attracting and sustaining members will prove difficult, but not impossible. In order to assemble a beneficial mix of public and private sector members, initiating a series of thorough stakeholder meetings is essential. The views of the Metropolitan Milwaukee Association of Commerce should be strongly considered, although greater conversation among all parties (such as those listed previously in the description of Alternative 3) is needed before a useful implementation strategy can be developed. Questions regarding the nature of investment, program eligibility, and specific organization goals should be asked to facilitate productive discussion.

The evidence used to reach a final recommendation relies on a variety of national and region-specific estimates; further research is necessary to conduct a thorough analysis of transportation in the Milwaukee Metropolitan Area before implementing the recommended policy or a similar policy. Regardless, this analysis importantly identifies transit access as a contributing source to broader issues of inequality, suggesting that any attempt to alleviate transit disparities could generate long-term economic benefits for the region.

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APPENDIX A: COST EFFECTIVENESS TECHNICAL APPENDIX

Baseline

The baseline condition is drawn from the Milwaukee County 2018 Recommended Operating Budget for the Milwaukee County Transit System. The baseline, all existing MCTS services as of 2018, provides the cost estimates for Alternative 1, the status quo.

Time scope and discount rate

The analysis is conducted over a period of nine (9) years with a discount rate of seven (7) percent. The analysis assumes all costs occur at year end.

Cost effectiveness criterion

Cost effectiveness measures the relationship between the primary outcome, passenger miles traveled (PMT), and cost in real 2018 dollars ($). The outcome considers all PMT and is not restricted to PMT only from low-income users. This is due in part to data limitations and to the fact that any PMT gain represents an improvement of transit services in region of analysis, producing some indirect benefits for the target population. Cost is calculated by dividing PMT by an alternative's total cost, identifying PMT per dollar.

General assumptions

Assumption	Value	Justification
Discount Rate	7%	Best practice from OMB
Inflation Rate	2%	Projection from OMB; all values provided in the analysis are adjusted for inflation
Commute (round-trip)	30 miles	Considers region size and national average

Alternative 1

Outcome assumptions

Assumption	Value	Justification
Average PMT Gain for 1 Passenger (annual)	0	Assumes zero gain in PMT
PMT (annual)	140,167,506	Actual figure per MCTS 2016 Agency Profile

Cost assumptions

Assumption	Value	Justification
Personnel Costs (annual)	$114,990,591.03	Assumes $108,668,180 (2016 dollars) per MCTS 2016 Agency Profile
Operation Costs (annual)	$156,364,356.78	Assumes figures from 2018 recommended MCTS budget
Capital Outlay (annual)	$159,375.00	Assumes figures from 2018 recommended MCTS budget
Debt & Depreciation (annual)	$3,395,576.94	Assumes figures from 2018 recommended MCTS budget
Interdepartmental Charges (annual)	$2,768,448.30	Assumes figures from 2018 recommended MCTS budget

The cost effectiveness figure for this alternative is calculated by dividing *Status Quo Baseline Cost by 2026 (Present Value)* by *Status Quo PMT by 2026:*

- Status Quo PMT by 2026: 1,261,507,554
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,935,778,652.98. The cost effectiveness is $1.53 per PMT.

Alternative 2

Outcome assumptions

Assumption	Value	Justification
Average PMT Gain for 1 Passenger (annual)	7,500	Assumes 30 miles per day, 50 working weeks per year, 5 days per week
Possible Benefitting Passengers (annual)	80	Assumes 30 passengers per stop at present and that amenities and convenience will attract more passengers
Uptake Percentage (annual)	100%	
Estimated Benefitting Passengers (annual)	80	Assumes *Possible Benefitting Passengers * Uptake Percentage*

The effectiveness measure for each year is calculated as follows:

- *Effectiveness =*
  *Average PMT Gain for 1 Passenger * Estimated Benefitting Passengers*
- EXAMPLE, Year 0: Effectiveness (Year 0) = 7,500 * 80 = 600,000

Total Program PMT by 2026 is calculated as follows:

- *Total Program PMT by 2026 =*
  *Effectiveness * 9 Years*
- Total Program PMT by 2026 = 600,000 * 9 = 5,400,000

Cost assumptions

Assumption	Value	Justification
Personnel Costs		
Hubs Manager (annual)	$0.00	Assumes role filled by existing MCTS employee (no additional costs)
Maintenance Workers (annual)	$0.00	Assumes roles filled by existing MCTS employees (no additional costs)
Value of Construction Worker's Time (hourly)	$18.58	Assumes adjusted BLS hourly wage
Hours Spent on Construction (annual)	2080	Assumes hours based on BLS 2016 mean salary divided by *Value of Construction Worker's Time (hourly)*
Length of Construction (years)	1	
Number of Construction Workers (annual)	5	
Operational & Administrative Costs		
Bike share Operation (annual)	$18,360.00	Assumes costs associated with bike repair, redistribution, customer service
Wayfinding Operation (annual)	$510.00	Assumes 24-hour electricity and other operating costs, as well as funding for maintenance

Assumption	Value	Justification
Bus Operation (annual)	$0.00	Assumes existing MCTS buses and oversight involved (no additional costs)
Carpool & Bus Infrastructure Maintenance (annual)	$1,224.00	Assumes equipment and major assets will not need to be replaced in time scope of the analysis; operation costs include station upkeep, structural repair costs
Capital Expenditures		
Bicycle Infrastructure (one-time)	$93,146.40	Assumes the following for each of the two (2) hubs: bike share equipment and installation, bike parking corral
Carpool Infrastructure (one-time)	$10,200.00	Assumes the following for each of the two (2) hubs: signage, pick-up and drop-off lane
Wayfinding Infrastructure (one-time)	$5,100.00	Assumes the following for each of the two (2) hubs: real-time MCTS signage (monitors, CPUs, cords, brackets, installation)
Bus Infrastructure (one-time)	$77,975.33	Assumes the following for each of the two (2) hubs: concrete bus pad, bus shelter, bus bench

Personnel Costs are calculated as follows:

- *Personnel Costs =*
  Hubs Manager + Maintenance Workers + Construction Workers
  - *Construction Workers =*
    *Value of Construction Worker's Time (hourly) * Hours Spent on Construction (annual) * Length of Construction (years) * Number of Construction Workers*
- EXAMPLE, Year 0: Personnel Costs (Year 0) =
  $0.00 + $0.00 + ($18.58 * 2080 hours * 1 year * 5 workers) = $193,277.76
- Personnel Costs by 2026 (Present Value): $193,277.76
  Note: Costs only occur in Year 0, resulting in a present value of $193,277.76 over the established time scope of this analysis.

Operational & Administrative Costs are calculated as follows:

- *Operational & Administrative Costs =*
  Bike share Operations + Wayfinding Operations + Carpool & Bus Infrastructure Maintenance
- EXAMPLE, Year 0: Operational & Administrative Costs (Year 0) =
  $18,360.00 + $510.00 + $1,224.00 = $20,094.00
- Operational & Administrative Costs by 2026 (Present Value): $140,081.27

Capital Expenditures Costs are calculated as follows:

- *Capital Expenditures Costs =*
  Bicycle Infrastructure + Carpool Infrastructure + Wayfinding Infrastructure + Bus Infrastructure
- EXAMPLE, Year 0: Capital Expenditures Costs (Year 0) =
  $93,146.40 + $10,200.00 + $5,100.00 + $77,075.33 = $186,421.73
- Capital Expenditures Costs by 2026 (Present Value): $186,421.73
  Note: Costs only occur in Year 0, resulting in a present value of $186,421.73 over the established time scope of this analysis.

Total Program Cost by 2026 (Present Value) is calculated as follows:

- *Total Program Cost by 2026 (Present Value) =*
  Personnel Costs + Operational & Administrative Costs + Capital Expenditures Costs
- Total Program Cost by 2026 (Present Value) = $193,277.76 + $140,081.27 + $186,421.73 = $519,780.76

The cost effectiveness figure for this alternative is calculated by dividing *Total Program Cost by 2026 (Present Value) + Status Quo Baseline Cost by 2026 (Present Value)* by *Total Program PMT by 2026 + Status Quo PMT by 2026*:

- Total Program PMT by 2026: 5,400,000
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value): $519,780.76
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,936,298,433.74. The cost effectiveness is $1.53 per PMT.

Alternative 3

Outcome assumptions

Assumption	Value	Justification
Year 0 to Year 1 (Pre-Program)		
Average PMT Gain for 1 Passenger (annual)	7,500	Assumes 30 miles per day, 50 working weeks per year, 5 days per week
Estimating Benefitting Passengers (annual)	0	Assumes zero PMT gain in years before TMA operation
Year 2 to Year 8 (Post-Program)		
Average PMT Gain for 1 Passenger (annual)	7,500	Assumes 30 miles per day, 50 working weeks per year, 5 days per week
Possible Benefitting Passengers (annual)	39,600	Assumes eight (8) 5,000-person organizations as membership base with 99% reach
Uptake Percentage (annual)	30%	
Estimated Benefitting Passengers (annual)	11,880	Assumes *Possible Benefitting Passengers * Uptake Percentage*

The effectiveness measure for each year is calculated as follows:

- *Effectiveness =*
  *Average PMT Gain for 1 Passenger * Estimated Benefitting Passengers*
- EXAMPLE, Year 0: Effectiveness (Year 0) = 7,500 * 11,800 = 89,100,000

Total Program PMT by 2026 is calculated as follows:

- *Total Program PMT by 2026 =*
  *Effectiveness * 7 Years*
- Total Program PMT by 2026 = 89,100,000* 7 = 623,700,000
  Note: PMT gains begin in Year 2, resulting in seven (7) years of benefits during the established time scope of this analysis.

Cost assumptions

Assumption	Value	Justification
Personnel Costs		
Executive Director Salary and Benefits (annual)	$106,080.00	Assumes $80,000 salary in 2018 dollars, benefits of 30% of annual salary
Executive Director Position Recruitment (one-time)	$3,060.00	
Employer Relations Coordinator Salary (annual)	$72,930.00	Assumes $55,000 annual salary in 2018 dollars, benefits of 30% of annual salary
Position Recruitment (one-time)	$3,060.00	
Value of Transportation Coordinator's Time (hourly)	$25.50	
Hours Spent on TMA (annual)	200	
Number of Member Organizations (varies by year)	5 (Year 0), 13 (Year 8)	Assumes five (5) member organizations in Year 0, an increase of 1 additional organization per year
Operational & Administrative Costs		
Office Space (annual)	$43,194.96	Assumes the following monthly expenses: $3,200 rent, $300 utilities, $29 technology and supplies
Contract Services (annual)	$2,065.50	Assumes 5% of salaried workers' benefits
Short-life Capital (one-time)	$1,326.00	Assumes costs associated with 2 computers and related software licenses, printing expenses
Incorporation and Filing Fees (one-time)	$724.20	
Year 2 Subsidy Program – Subsidies (annual)	$127,007.77 (Year 2 Present Value)	Assumes 12-gallon average gas tank, $2 per gallon subsidy, volume of *Estimated Benefitting Passengers* divided by 2 (number of predicted individuals per car)

Assumption	Value	Justification
Year 2 Subsidy Program – Time (annual)	$1,889,208.88 (Year 2 Present Value)	Assumes $18.39 hourly value of commute time (based on $37,495 median income in Milwaukee in 2018 dollars), 9.9 additional hours spent commuting (15% of 66 status quo commuting hours in Milwaukee), 2 people per car, 5,940 carpools

Personnel Costs are calculated as follows:

- *Personnel Costs* =
  Executive Director + Employer Relations Coordinator + Transportation Coordinators
- EXAMPLE, Year 0: Personnel Costs (Year 0) =
  ($106,080.00 + $3,060.00) + ($72,930.00 + $3,060.00) + ($25.50 * 200 hours * 5 organizations) = $210,630.00
- Personnel Costs by 2026 (Present Value): $1,499,112.78
  Note: Position recruitment costs for the two (2) permanent positions only occur in Year 0. Alternative also assumes that each subsequent year will result in one additional member organization recruited, increasing annual costs associated with Transportation Coordinators.

Operational & Administrative Costs are calculated as follows:

- *Operational & Administrative Costs* =
  Office Space + Contract Services + Short-life Capital + Incorporation and Filing Fees + Year 2 Subsidy Program – Subsidies + Year 2 Subsidy Program – Time
- EXAMPLE, Year 0: Operational & Administrative Costs (Year 0) =
  $43,194.96 + $2,065.50 + $1,326.00 + $724.20 = $47,270.16
- EXAMPLE, Year 2: Operational & Administrative Costs (Year 2 Present Value) =
  $37,728.15 + $1,768.71 + $127,007.77 + $1,889,208.88 = $2,055,713.52
- Operational & Administrative Costs by 2026 (Present Value): $11,943,885.34
  Note: Costs occur annually with the exception of: Short-life Capital (one-time cost in Year 0), Incorporation and Filing Fees (one-time cost in Year 0), and costs associated with Year 2 Subsidy Program (costs begin in Year 2).

Total Program Cost by 2026 (Present Value) is calculated as follows:

- *Total Program Cost by 2026 (Present Value) =*
  Personnel Costs + Operational & Administrative Costs
- Total Program Cost by 2026 (Present Value) = $1,499,112.78 + $11,943,885.34 = $13,442,998.11

The cost effectiveness figure for this alternative is calculated by dividing *Total Program Cost by 2026 (Present Value) + Status Quo Baseline Cost by 2026 (Present Value)* by *Total Program PMT by 2026 + Status Quo PMT by 2026*:

- Total Program PMT by 2026 = 623,700,000
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value) = $13,442,998.11
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,949,221,651.09. The cost effectiveness is $1.03 per PMT.

Alternative 4

Outcome assumptions

Assumption	Value	Justification
Average PMT Gain for 1 Passenger (annual)	0	Assumes 0 PMT gain because option replaces existing pathways, does not add geographic reach
Possible Benefitting Passengers (annual)	39,780	Based on MCTS route ridership figures
Uptake Percentage (annual)	100%	
Estimated Benefitting Passengers (annual)	39,780	Assumes *Possible Benefitting Passengers * Uptake Percentage*

The effectiveness measure for each year is calculated as follows:

- *Effectiveness =*
  *Average PMT Gain for 1 Passenger (annual) * Estimated Benefitting Passengers*
- EXAMPLE, Year 0: Effectiveness (Year 0) = 0 * 39,780 = 0

Total Program PMT by 2026 is calculated as follows:

- *Total Program PMT by 2026 = Effectiveness * 9 Years*
- Total Program PMT by 2026 = 0 * 9 = 0
  Note: This option produces 0 PMT gain because the option replaces existing pathways, resulting in a transfer of PMT rather than a gain.

Cost assumptions

Assumption	Value	Justification
Personnel Costs		
Public-Private Partnership Coordinator (annual)	$0.00	Assumes role filled by existing MCTS employee (no additional costs)
Value of Software Developer's Time (hourly)	$51.14	Assumes adjusted BLS hourly wage
Hours Spent App Development & Systems Integration (annual)	640	Assumes 16 weeks, 40 hours per week
Value of TNC Driver's Time (hourly)	$35.07	Assumes projections for Milwaukee by Uber
Hours Spent Driving (annual)	1500	Assumes 50 weeks, 30 hours per week
Number of TNC Drivers Employed for PPP (annual)	10	
Operational & Administrative Costs		
Mobile App Development & Systems Integration (annual)	$6,546.28	Assumes 20% of initial development costs (function of wage rate and development hours)
Marketing & Advertising (annual)	$45,262.50	Assumes opportunity cost of placing MCTS ads in buses (100 buses at $50 each) and at shelters (75 shelters at $525 each)

Assumption	Value	Justification
Commute Time (annual)	$12,071,038.12	Assumes $18.39 hourly value of commute time (based on $37,495 median income in Milwaukee in 2018 dollars), 16.5 additional hours spent commuting (25% of 66 status quo commuting hours in Milwaukee), volume of *Estimated Benefitting Passengers*
Private Vehicle Maintenance (annual)	$94,115.40	Assumes average cost to own a vehicle in 2015 was $8,698
PPP Subsidies (annual)	$202,878.00	Assumes $5 subsidy in 2018 dollars, volume of *Estimated Benefitting Passengers*
Averted Costs		
Retired MCTS Lines (annual)	($689,785.20)	Assumes $17 per rider in 2018 dollars, volume of *Estimated Benefitting Passengers*

Personnel Costs are calculated as follows:

- *Personnel Costs* =
  Public-Private Partnership Coordinator + Software Developer + TNC Drivers
- EXAMPLE, Year 0: Personnel Costs (Year 0) =
  $0.00 + $32,731.39 + $526,014.00 = $558,745.39
- Personnel Costs by 2026 (Present Value): $3,699,732.00
  Note: Costs associated with the Software Developer only occur in Year 0.

Operational & Administrative Costs are calculated as follows:

- *Operational & Administrative Costs* =
  Mobile App Development & Systems Integration + Marketing & Advertising + Commute Time + Private Vehicle Maintenance + PPP Subsidies – Averted Costs
- EXAMPLE, Year 0: Operational & Administrative Costs (Year 0) =
  $6,546.28 + $45,262.50 + $12,071,038.12 + $94,115.40 + $202,878.00 - $689,785.20
- Operational & Administrative Costs by 2026 (Present Value): $81,697,969.20

Total Program Cost by 2026 (Present Value) is calculated as follows:

- *Total Program Cost by 2026 (Present Value) = Personnel Costs + Operational & Administrative Costs*
- Total Program Cost by 2026 (Present Value) = $3,699,732 + $81,697,969.20 = $85,397,701.21

The cost effectiveness figure for this alternative is calculated by dividing *Total Program Cost by 2026 (Present Value) + Status Quo Baseline Cost by 2026 (Present Value)* by *Total Program PMT by 2026 + Status Quo PMT by 2026*:

- Total Program PMT by 2026 = 0
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value) = $85,397,701.21
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $2,021,176,354.18. The cost effectiveness is $1.60 per PMT.

APPENDIX B: SENSITIVITY ANALYSIS OF ALTERNATIVE 3

The author conducted a sensitivity analysis for the recommended option, Alternative 3, testing three different assumptions. Unless otherwise indicated, the assumptions used reflect those in Appendix A.

Original Analysis

The original cost effectiveness figure for Alternative 3 is calculated by dividing *Total Program Cost by 2026 (Present Value) + Status Quo Baseline Cost by 2026 (Present Value)* by *Total Program PMT by 2026 + Status Quo PMT by 2026*:

- Total Program PMT by 2026 = 623,700,000
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value) = $13,442,998.11
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,949,221,651.09. The cost effectiveness is $1.03 per PMT.

Sensitivity 1

Sensitivity 1 assumes half the number of possible benefitting passengers of the original analysis (5,940 versus 11,880). This decreases the annual estimated PMT for this program by half from 89,100,000 to 44,550,000.

- Total Program PMT by 2026 = 311,850,000
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value) = $7,629,701.47
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,943,408,354.44. The cost effectiveness is $1.24 per PMT.

Sensitivity 2

Sensitivity 2 assumes double the number of additional commute hours (19.8 hours vs. 9.9 hours). This increases the estimated costs associated with commute time in Year 2 from $1,889,208.88 to $3,778,417.76.

- Total Program PMT by 2026 = 623,700,000
- Status Quo PMT by 2026: 1,261,507,554

- Total Program Cost by 2026 (Present Value) = $24,337,196.05
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,960,115,849.03. The cost effectiveness is $1.04 per PMT.

Sensitivity 3

Sensitivity 3 assumes the non-profit would not be operational until Year 3 (versus Year 2), delaying the potential for PMT gains by one year. This reduces the total program PMT by 89,100,000 when compared to the original analysis of Alternative 3.

- Total Program PMT by 2026 = 534,600,000
- Status Quo PMT by 2026: 1,261,507,554
- Total Program Cost by 2026 (Present Value) = $11,426,781.46
- Status Quo Baseline Cost by 2026 (Present Value): $1,935,778,652.98

Total cost estimates, after discounting, equal a present value of $1,947,205,434.44. The cost effectiveness is $1.08 per PMT.