Public Transportation Strategy Paper

Chicago Metropolitan Agency for Planning
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Introduction

The Chicago metropolitan region has one of the nation's oldest and most extensive public transportation systems. The region's three transit agencies provide over two million rides per weekday in a region of approximately eight million people. In recent years service expansions and innovative strategies have been introduced to increase the ease of use and interconnectedness of the system. After declines in ridership through the 1980s and 1990s, system wide ridership has been steadily increasing for the past five years (RTAMS 2008).

At the same time, much of the system is in need of infrastructure upgrades and improvements. Basic repair and maintenance costs for the current system are estimated in the billions of dollars, while system expansions and enhancements would add even more expense. With 2.8 million new residents and 1.8 million new jobs projected to be added to the region by 2040, changing growth and development patterns will require new transit services to provide adequate access for the region's residents.

As the region moves forward with development of the *GO TO 2040* comprehensive plan, it is important to understand the challenges facing our transit system and potential strategies to improve transit. This paper will not lay out specific proposals for expanding the public transportation system or evaluate individual major capital projects. Instead, this paper will identify and discuss broad systematic improvements such as increasing the frequency of service or expanding services into underserved areas and the impacts that these changes may have on the region.

This paper relies heavily on information from two previous reports: the *2030 Regional Transportation Plan;* and *Moving Beyond Congestion*, the strategic plan published by the Regional Transportation Authority in 2007.

According to the American Public Transportation Association (APTA), public transportation "is transportation by a conveyance that provides regular and continuing general or special transportation to the public, but not including school buses, charter or sightseeing service" (APTA 2008a). This paper will use the terms "public transportation," "public transit," "transit," and "mass transit" interchangeably to refer to bus or train service operating on fixed routes and regular schedules; demand-responsive services including vanpools and paratransit will generally be referred to specifically.

Background and Current Conditions

Northeastern Illinois public transportation structure

The region is served by three public transportation providers:

- The **Chicago Transit Authority (CTA)** offers bus and heavy rail service within the City of Chicago and 40 nearby suburbs. The CTA system is the second largest public transportation system in the country and provides 1.6 million rides on an average weekday. CTA's bus system serves over 12,000 posted stops on 2,200 miles of roadway while the heavy-rail system (the "El") serves 144 stops on over 224 miles of track (CTA 2008a).

- **Pace** offers suburban bus service throughout the greater metro area as well as providing vanpool, demand-responsive paratransit service, and ride matching (carpooling) information for the entire region including Chicago. Pace operates over 700 buses that provided 39.2 million rides in 2007. The 700 vanpools operated by Pace had nearly 800,000 riders in 2007 and the demand-responsive service provided nearly 2.7 million trips (Pace 2008a; FTA 2007).

- **Metra** provides commuter rail service throughout the region. Operating from four downtown Chicago transit stations, Metra serves 230 stations on over 1100 miles of track; in 2007 the system provided over 83 million rides (RTAMS 2008a).

2007 RTA System Statistics (RTAMS 2008a, 2008b)

	CTA Bus	CTA Rail	Metra	Pace Bus	Total
Lines/Routes	154	8	12	228	
Rail Cars/Buses	1,827	1,190	956	746	
2007 Unlinked Rides (millions)	309.3	190.3	83.3	39.1	621.9

The three service providers are governed by the **Regional Transportation Authority (RTA)** whose mission is to "ensure financially sound, comprehensive, and coordinated public transportation for northeastern Illinois." While CTA, Pace, and Metra's Boards of Directors are each responsible for setting their levels of service, fares, and operational policies, the RTA provides oversight of these decisions, particularly budgeting issues. Additionally, the RTA is responsible for decisions requiring a regional perspective, including coordination of transportation services across the three service providers, coordinated market development, and compliance with state and federal guidelines (RTA 2008a).

Regarded as one system, the three service providers create a comprehensive network of public transportation for the region. Serving over 200 communities, CTA, Pace, and Metra provided over 620 million unlinked trips in 2007 (RTAMS 2008a). Public transportation accounts for approximately 12.5 percent of work commute trips and 5.6 percent of all trips throughout the region (Chicago Metropolis 2020 2007b). Use of private automobiles, usually with a single person in them, make up the vast majority of the rest of the trips, although bicycling, walking, and carpooling also comprise small shares of the total trips made in the region.

Increasing demand and rising costs

Recent increases in gas prices have corresponded to increased demand for public transportation. As gas prices have risen, citizens have found it increasingly cost effective to leave their personal vehicles at home and use public transportation for trips to work, to school, for errands, and for recreational purposes. The American Public Transportation Association (APTA) reported that national public transportation usage increased 3.4 percent during the first quarter of 2008 compared to the previous quarter (APTA 2008b). Year-over-year, ridership in the region has shown even sharper gains (RTAMS 2008a):

August 2007 and August 2008 Average Daily Weekday Boardings

	CTA Bus	CTA Rail	Metra	Pace Bus	Total
2007	931,227	514,904	316,700	113,810	1,876,641
2008	1,013,700	551,329	337,680	120,304	2,023,013
Change	82,473	36,425	20,980	6,494	146,372
% Change	9%	7%	7%	6%	8%

Adding to rising demand, in January 2008 Illinois lawmakers passed Public Act 95-0708 providing annual operating funds for the state's public transportation systems. A provision of this bill provides free rides on fixed route systems for senior citizens living in the RTA's service area. Known as "Seniors Ride Free," this program is designed to boost transit accessibility for older residents. The program allows any senior citizen with a special transit ID to ride any CTA bus or train, Pace buses, and Metra trains for free (Regional Transportation Authority 2008b). While providing a great benefit for the region's growing population of seniors, the Seniors Ride Free program has further increased demand for transit service without providing any additional revenue to service providers. Free rides were also extended to low-income disabled residents later in 2008.

While rising fuel costs have increased the ridership of public transportation systems, they have also impacted the budgets of transit providers. According to an APTA survey released in May 2008, the price of diesel fuel for transit providers had risen 166 percent in the past four years while the price of electricity rose 18.9 percent in the same period. Most CTA and Pace buses and the majority of Metra locomotives are diesel powered, while all CTA and some Metra trains rely on electric power. The sharp rise in fuel costs for providers has not been offset by increased fare revenue and many transit providers are in the difficult position of considering service cuts or fare hikes at the same time that they experience record-high ridership and demand for services (APTA 2008b). While service cuts have not been announced by any of the region's transit providers, higher fuel costs are putting increased pressure on their operating budgets.

A further constraint on the budgets of the region's transit providers is a statutory regulation that they recover half of their operating costs from fares or other operating revenue (RTA Act). The purpose of this is to ensure that the public subsidy of the transit system does not exceed 50 percent of the system's cost. There are a number of exceptions to the recovery ratio requirement, and when these were taken into account, the 2007 recovery ratio for all three providers was 51.6% (RTA 2008c).

State of repair

Maintaining one of the nation's oldest and most extensive public transportation systems is a challenge. With over 700 miles of rail, over 5,000 buses, rail cars and locomotives, and numerous stations and maintenance facilities, on-going repair and replacement of facilities, infrastructure, and vehicles is an expensive process. While the State of Illinois historically supported capital programs for CTA, Metra, and Pace, limited state capital funding from 2004 to 2007 caused the agencies to defer repair and maintenance of their systems and refurbishment and replacement of aging vehicles (RTA 2007). Coupled with aging infrastructure, this led to increased vehicle breakdowns, rail "slow zones" in which trains cannot run at normal speeds, and deteriorating station and passenger areas.

Recognizing this, the RTA's report requested increased funding of the region's transit system. It called for a total of $10.4 billion in capital funding and expenditures over the next five years and $57 billion over the next 30 years in order to "maintain, enhance, and expand" the region's public transportation system. In the near term, the vast majority of this funding is designated to bring the current transit system into a state of good repair. Specifically, the report called for spending $7.3 billion over the next five years on:

- Rolling Stock: For safety reasons and to modernize the fleet, funds are needed to replace aging trains, buses and vans that are beyond their useful life.
- Track and Structure: Train tracks, railroad ties, bridges and viaducts need repairs. Metra has over 1100 miles of track and 800 bridges; CTA has over 224 miles of total track – including 50 miles of track on elevated structures and 24 miles of track in subway tunnels – as well as 115 bridges and viaducts. To speed travel times and avoid slow zones, repairs are needed to rails and ties, bridges and structure and repairing signals, electrical systems and communications.
- Passenger and Support Facilities and Equipment: Significant funds are needed to improve train stations and parking lots serving riders as well as repair facilities for trains and buses both in the city and the suburbs (RTA 2007).

Funding these projects would bring the current system into a state of good repair, but would not enhance or expand the system to meet rising demand. The remaining $3.1 billion called for in *Moving Beyond Congestion* would be used to add service on current routes, speed current service, offer additional commuting options, and lay the groundwork for expansion.

Chicago Metropolis 2020, a business-based civic organization, produced an additional report on the economic value of transit to the region. In *Time is Money, The Economic Benefits of Transit Investment,* the group stated that the funding RTA requested would result in a return on investment of at least 21 percent and as much as 64 percent if additional funds were allocated and transit improvements were tied to changes in land use planning. (Chicago Metropolis 2020 2007a). At the same time, if the investments called for by the RTA were not made, the cost to the local economy in increased traffic congestion, lost time, and lost business potential would exceed $2 billion annually. In this scenario, by 2020 the region would suffer an 11 percent reduction in daily linked transit trips (approximately 187,000 trips) due to deteriorating conditions and gain 925,000 new residents, resulting in dramatically increased road congestion. Concluding that even more should be invested in transit improvements than the RTA requested, the report stated that "the RTA proposals are economically sound, but even more must be done" (Chicago Metropolis 2020 2007b). Within this context, it is critical to not only seek an appropriate level of funding for the transit system, but to pursue a variety of strategies to increase efficiency and reduce costs.

Systematic Public Transit Improvements

This section of the report lays out systematic improvements that could be made to the public transit system. "Systematic" excludes major capital projects (such as the Metra STAR Line or the CTA Circle Line), which are addressed separately in the *GO TO 2040* process, but includes operational, technological, or relatively small-scale capital improvements.

Systematic improvements that could improve the transit system are grouped below in several categories, including traveler information, service improvements, service extensions, improvements to fleets or facilities, multimodal coordination, fare changes, and others.

Traveler information

Research has shown that riders are more comfortable waiting for a known period of time for a bus or a train than for an unknown period, meaning that providing accurate, real-time information can increase the attractiveness of the system (TCRP 2004). Travel information can be conveyed through electronic signs at bus and train stations, displaying arrival times for next trains, service changes, delays and incident information. The information can also be transmitted to the internet and wireless devices; ideally, information would be available both at stations and online.

Other major metropolitan areas have recently begun the installation of travel information systems at transit stops. In New York City, the Metropolitan Transportation Authority has been testing out the installation of such a system on the L Line of their subway system, at a cost of $17.6 million (Neuman 2007). Toronto recently signed a contract for $9.9 million to complete the system for their transit operations. Toronto has four subway lines and more than 140 bus routes. They have calculated the cost of 350 bus shelter components at $4.7 million (Gray 2008).

The RTA and the three service boards recognize the importance of traveler information and each have programs that seek to capitalize on this. These include:

The RTA's Trip Planner allows users to enter start and end locations and time of day for a trip and then provides the best transit options for them. The tool allows users to specify bus only, train only, or bus and train trips; departure or arrival times; maximum walking distances; and trips that have the lowest travel time, lowest number of transfers, or lowest amount of walking. Based on user inputs, the tool provides walking directions to the start location, the transit services used, walking directions to the end location, total time for the trip, and total price for the trip.

CTA's Bus Tracker currently provides two separate services. The first provides estimated arrival times for the next bus at a user-specified stop. This service is available in a graphical version for computer use and a text-only version for mobile phone use, for many bus routes. The second service provides a graphical interface that displays the real-time locations of all stops and buses on a given route on a Google Maps™ interface. Using these services, users can easily and accurately determine where buses are on their route and when they will arrive at their station. Also, the CTA recently announced a Public-Private Partnership in which rail stations will be equipped with digital displays for emergency communication and arrival times in exchange for advertising rights. These displays, along with others installed on the side of some buses, will be free for the CTA and generate $100 million over the 10 year contract (CTA 2008d). Additionally, the CTA plans to introduce a Short Message System (SMS) "texting" interface to real-time bus location information via numbers posted on bus stop signs during 2009.

Pace's WebRoute has an interactive mapping tool that allows users to customize a map of the region and display specific information such as Pace, Metra, and CTA routes and stops, major landmarks, and the street system. While not providing real-time vehicle locations, WebRoute allows users to easily find routes in specific areas and determine distances between locations.

Metra utilizes an advanced Parking Management Guidance System at two of its suburban stations with park-and-ride facilities. This system uses vehicle detections systems to monitor parking areas and electronic signage to inform arriving vehicles about available parking. Such systems can reduce the amount of time drivers spend searching for parking and subsequently reduce vehicle emissions at parking facilities (JPOITS 2007).

Service improvements

Service improvements, including increasing frequency and speed of service, will make public transportation more appealing to all potential users. Speed increases can be accomplished for rail by eliminating rail "slow zones," making other capital improvements, and vehicle and station improvements (described later). Bus service speed can be improved through increasing the distance between stops, giving transit vehicles signal priority at intersections, and other capital improvements including roadway modifications. Increasing the frequency of transit service also helps to increase its desirability.

Providing improvements in traffic operations for transit vehicles, particularly buses, can reduce travel times; these improvements can include signal prioritization, bus turnouts, bus turn around areas, and priority placement of bus stops. These improvements can slightly reduce bus travel times while also making travel times more consistent from trip to trip, improve traffic flow as buses in turnouts are not blocking traffic lanes, and also lead to safety improvements as buses are not stopping in travel lanes (CATS 1998).

One notable improvement is Transit Signal Priority (TSP), which provides buses with signal priority at specific intersections along their routes. In a common application of TSP, as a bus approaches an intersection the system checks if the bus is on schedule, and if not, the system can hold a green light longer so the bus makes the signal, or can even change signals specifically for the bus. Coordinated signals can also be combined with short bus lanes at intersections to allow buses to bypass other traffic on the roadway at intersections in a process known as "queue jumping." These improvements allow transit vehicles to hold their schedules better and allow for more consistent travel times. Experience in 10 US cities and abroad show up to 20% improvement in bus travel times, and several studies show significant reductions in travel time variability, with a corresponding improvement in on-time performance. By reducing idling time for buses, TSP may also reduce emissions and create improvements in fuel economy (FHWA 2003).

Within the region, TSP will be an integral part of Bus Rapid Transit (BRT) and Arterial Rapid Transit (ART) lines that are currently under development by Pace and CTA. For example, beginning in 2009, the CTA will be implementing a BRT pilot program along select corridors to determine how BRT technology can best be implemented on a broad scale in the Chicago area (CTA 2008e). Pace has used TSP for a number of years on Cermak Road which has resulted in transit travel time reductions of 7 to 20 percent (Pace 2008b); the application of this technology is also underway on Halsted Street through southern Cook County. (Please note that BRT projects that include new, dedicated right-of-way are generally considered major capital facilities, and therefore not described in this paper, which focuses on systematic improvements.)

Several studies have found that high-quality transit service also increases travel speeds on parallel highways (Morgridge, 1990; Lewis & Williams, 1999; Vuchic, 1999). Cross-city comparisons also indicate that total congestion delays tend to be lower in areas with fast and frequent transit service (STTP, 2001; Litman, 2004a). This occurs because faster transit services draw more users because of the decreased travel times. Therefore, improvements to the transit system that lead to increased transit speeds are also expected to reduce congestion on nearby roadways (Litman 2007).

Service extensions

Bus service in dense urban areas within the region is generally frequent and extensive. However, service outside this area is less frequent and less accessible. Pace has continually looked for options to expand or improve bus service in currently unserved or underserved areas, and has produced a series of studies recommending improvements or restructurings, available online at http://www.pacebus.com/sub/initiatives/st_default.asp.

National studies have shown that service expansions are an effective way to increase the attractiveness of transit service and generate new ridership. Service expansions in suburbs and "edge cities" that are traditionally poorly served by transit tend to achieve better ridership response to service expansions than central cities and commuting corridors that are often better served by transit. This is particularly true when the service expansions tie into other services such as rail access or express buses. A recent study of ridership elasticities in response to service expansions in the San Diego area estimated elasticities of between +0.65 and +1.01, meaning that a 100% increase in service levels would increase ridership by between 65% and 101%. Additional studies in suburban Montgomery County, MD, and Santa Clara County, CA, showed peak service elasticities of +1.14 and +1.17 respectively and long-term (20 year) service elasticities of +1.07 and +1.42 respectively (Pratt et al 2004). A similar analysis was done for a series of major service expansions that occurred during the 1970s, estimating elasticities between +0.86 and +1.34 (Pratt et al 2004).

When frequent bus and rail service is not feasible in low-density areas, other public transportation options may be. Vanpools, ride matching (carpooling), and employer specific shuttles can be effective for commuters in these areas. More information on each of these is contained in the forthcoming Transportation Demand Management (TDM) strategy report. Google has set the bar nationally with its shuttle program in Silicon Valley – an area not well served by public transportation. Google transports almost a quarter of its workforce on coach buses with leather seats, wireless internet access, and bicycle racks, saving its employees money and removing approximately 1,200 cars from area roads daily (Helft 2007). Programs like Google's could be particularly successful for large employers not based near rail stations.

Facility and fleet improvements

High-quality passenger facilities that offer clean and safe spaces for passengers to wait for their bus or train out of the weather will increase passenger comfort. Well designed facilities, particularly larger rail stations, can increase visibility for the service, provide a positive "first impression" for transit users, and offer the opportunity to integrate retail and dining amenities that increase passenger satisfaction. These improvements are anticipated to have the effect of increasing ridership (CATS 1998). Secured bus stops that allow riders to prepay before the bus arrives (as is done with CTA rail stations) can also increase bus speeds by shortening loading time (TCRP 2003).

Beyond this, services such as wireless internet access, particularly on longer commuter rail or bus routes, can attract new users to the system. Interactive maps at stations and in vehicles that display the vehicle's location on a system or regional map can make new users and visitors more comfortable using the transit system.

Fleet improvements and upgrades can also lead to increased ridership. Using new or rehabbed vehicles for use on public transit routes can improve comfort and convenience, reduce maintenance and fuel costs, and improve reliability. Experience from other parts of the country has shown that ridership can increase with the introduction of new vehicles (CATS 1998). As an example, the use of low-floor buses has been recommended by some experts, due primarily to quicker boarding times at stops (King 1998). The use of alternative fuels is also increasingly popular, both nationally and in the region, and will be covered in more detail in a forthcoming strategy paper on alternative fuels and vehicle technology.

Mulitmodal coordination

Coordination between service providers is critical for providing a seamless experience for transit users. The RTA leads this effort, and in 2001 produced a report on transit coordination options (RTA 2001).

In addition to coordination between transit services, links to other modes are important. Many trips on public transportation do not begin or end within walking distance of a transit stop, but are within easy bicycling distance. With this in mind, all three service providers have expanded the ability of bicycle users to bring their bicycles with them on transit. Both CTA and Metra allow up to two bicycles in each rail car during non-peak weekday service and on the weekends. Pace began adding bicycle racks to the front of their buses in 2000 and by 2002 every bus in the fleet was equipped with a rack; CTA provides similar racks on the front of their buses. Additionally, CTA, Pace, and Metra all provide bicycle racks at many of their stations, with indoor and sheltered racks increasingly common. For additional information about bicycling in the region see CMAP's Bicycle Strategy Report <http://www.goto2040.org/bicycling.aspx>.

CTA has partnered with two car-sharing providers, I-GO and Zipcar, to provide parking for 45 cars at 20 rail stations. I-GO and Zipcar are membership based organizations that allow users to rent vehicles on an hourly basis for short trips and errands. Studies have shown that providing car sharing at transit stations increases the use of public transportation as it provides increased flexibility and travel options to users (CTA 2008c). For additional information about car sharing see CMAP's Car Sharing Strategy Report <http://goto2040.org/carsharing.aspx>.

Coordination of fares by transit providers has also been pursued by the RTA. While there is some coordination between service boards on fare payment, a unified payment method or "universal farecard" has not yet been developed. There is general acceptance that fare coordination is desirable, but the many institutional and technological issues have not yet been solved.

Fare changes

As described earlier, transit operators in the region are responsible for meeting farebox recovery ratios, and this has a substantial impact on fare levels. Fare increases often increase system revenues but decrease ridership, and are often measured in terms of elasticities. Studies have found that the effect of bus fare changes on ridership is approximately -0.40, meaning that a 100% fare increase would decrease ridership by 40% (or more reasonably, a 10% increase would lead to a 4% ridership decrease). Heavy rail elasticities average -0.17 to -0.18. Rider sensitivity to fare changes appears to decrease as metro and system sizes increase, likely because these systems are more competitive with auto travel costs than smaller systems in smaller metro areas Fare increases have a greater impact on off-peak ridership than on peak ridership (McCollom et al 2004). Some sample elasticities from systems nationwide are in the tables below.

Sample Fare Elasticities (Table 12-3, page 12-11)

City	Period	Bus Fare ε	Rail Fare ε
Chicago	1981-1986	-0.43	-0.18
London	1971-1990	-0.35	-0.17
New York	1948-1977	-0.32	-0.16
New York	1970-1995	-0.20 to -0.30	-0.10 to -0.15
New York	1995	-0.36	-0.15
Paris	1971	-0.20	-0.12
San Francisco	1984-1986	-	-0.31

Peak and Off-Peak Bus Fare Elasticities (Table 12-7, page 12-14)

City	Peak Bus Fare ε	Off-Peak Bus Fare ε
Spokane, WA	-0.32	-0.73
Grand Rapids, MI	-0.29	-0.49
Portland, OR	-0.20	-0.58
San Francisco, CA	-0.14	-0.31
Los Angeles, CA	-0.21	-0.29

Fare elasticities also work the other way, in that fare decreases or targeted incentives can increase ridership. Fare incentives most commonly provide special or reduced fares by time of day, frequency of use, or demographic characteristics.

If fare increases are necessary, ridership losses can be minimized by simultaneously increasing the discount available for prepaid fares. According to McCollom et al, this approach led to ridership increases in Chicago and Denver, while slightly decreasing in Philadelphia; Richmond had a larger decrease. Fewer riders appear to be lost when larger fare increases are targeted to users with low fare sensitivity than when uniform fare increases are given to all riders (McCollom et al 2004).

Offering reduced (or free) fares during off-peak travel times can promote transit usage during off-peak times, shifting users from crowded peak period service to less crowded off-peak service, and more properly reflect the higher cost of service during peak periods. Fare shifts in Denver, Louisville, Lowell, and Trenton from flat fares or slightly different peak/off-peak fares to more dramatic peak/off-peak differences led to significant shifts in ridership from peak periods to off-peak periods. At the same time, total ridership stayed flat in Lowell, MA, but increased 10-15% in Trenton and 34% in Denver, which was free during off-peak periods (McCollom et al 2004).

It should be noted that the varying price of fuel has changed some of the dynamics around public transit elasticities regarding fares and ridership. In times of high gas prices, ridership may increase even if fares are increased because the cost of driving is increasing even faster. In other words, volatile fuel prices make it difficult to predict short-term ridership response to fare changes.

Other strategies

Beyond the strategies identified above, there are other systematic strategies that can improve transit system performance and attract new riders.

The use of AVL (Automatic Vehicle Location) systems can lead to improved on-time performance and potential capital savings. These systems, which provide real-time monitoring of vehicle locations, can spotlight inefficiencies and problem areas that may result in delays and other issues, reducing vehicle needs while also improving schedule adherence. System costs vary for implementation and ongoing expenses; recently, Denver installed a GPS-based system for $10.4m in capital costs and $1.9m in annual Operations & Maintenance (O& M) costs for a 1,355 vehicle fleet. In Kansas City, the transit agency was able to eliminate 7 buses (out of 200) by using AVL data to track inefficiencies, resulting in annual capital savings of $1.5m and operating expenses of $400,000, which was enough to amortize the cost of the AVL system in two years (Jones 1995). It is estimated that an AVL/CAD system must reduce fleet size by 2.3% to break even, but many operators report reductions of 4-9%. On-time performance can also benefit; schedule performance was improved by 20-30% when AVL systems were applied in Baltimore, Denver, and Milwaukee (FHWA 2003; Jones 1995). Within the region, both Pace and CTA have used AVL systems for route planning and evaluation (Balvanyos and Owen).

Using AVL systems on paratransit vehicles allows dynamic routing and scheduling, which can allow better coordination of ridesharing and potentially better routing of some vehicles. While system costs vary widely depending on the features, per-vehicle costs are relatively low if a system is already in place for the transit system, and benefits are high. For example, installation of an AVL system in 40 paratransit vehicles in San Jose, CA, led to an increase in shared rides from 38% to 55% of all rides due to efficiencies exploited by the automated scheduling and routing system (FHWA 2003).

Increased transit marketing programs and transit usage information can also increase ridership. Marketing programs promote specific features of a transit system; these can be narrowly focused at specific groups of users or more broadly used to increase general awareness of the transit system. Informational materials focus on increasing the ease of use of a transit system by clearly communicating how the system works and its benefits to users. By increasing awareness of the system and making it simple to use through clear informational displays, marketing programs and information measures can increase ridership. According to some studies, a “typical” package of marketing and information measures can result in a 0.5% increase in ridership. More aggressive marketing combined with other changes such as reduced fares and route and schedule adjustments has been credited with ridership increases ranging from 20 to 25% (CATS 1998).

The use of variable pricing for parking or roadways (also known as congestion pricing) can lead to increases in transit ridership if high-quality transit service is provided during times when prices are highest. Congestion pricing is described in more detail in the Managed Lanes strategy paper< http://goto2040.org/managedlanes.aspx >, and variable pricing of parking will be described in a forthcoming paper on this subject.

While not covered in this paper, the effectiveness and attractiveness of transit systems is highly dependent on nearby land use patterns. The Urban Design strategy paper < http://goto2040.org/urbandesign.aspx > describes the benefits of Transit Oriented Development (TOD) and its positive effect on the use of alternative transportation modes. Planning for transit service and supporting land use should be done together, and this linkage between land use and transportation is at the heart of the *GO TO 2040* plan.

Major capital projects

This paper has deliberately avoided discussion of major capital projects including new rail or BRT systems. Major capital projects are treated separately within the *GO TO 2040* process. They are meant to support, rather than drive, the recommendations of the plan. New or expanded rail lines, grade separations, busways with exclusive rights-of-way, and major new stations will be addressed individually instead of systematically.

Impacts of Public Transportation

An improved public transportation system will have impacts on almost every aspect of the region – from the environment, to congestion, to housing patterns and land value. Public transportation systems offer numerous benefits to users of the system as well as those living in or traveling through communities with transit systems. The relationships between improved transit service and key regional indicators are described below and quantified if possible.

Transportation

Public transportation reduces Vehicle Miles Traveled (VMT) and congestion
Providing public transit service reduces congestion on roadways by shifting drivers from single-occupancy vehicles off the roadway. Litman found that cities with large rail transit systems have 21% lower per capita VMT than cities with no rail transit system (2006a). Bento, et al (2003), as cited in Litman, concluded that “a 10% increase in rail supply reduces the probability of driving by 4.2 percent.” Further, a “10% increase in a city’s rail transit service reduced 40 annual VMT per capita (70 VMT if New York is included in analysis)” (Ibid 2006a).

Congestion is a major problem in the Chicago region. According to the Texas Transportation Institute (TTI) which publishes national transportation statistics, the region suffered over 202 million hours of person delays in 2005, the third worst in the nation. This figure works out to a per-person delay of 46 hours per year. Additionally, the region's travel time index is the second worst in the nation at 1.46; this means that a trip that regularly takes an hour in uncongested conditions will take nearly 88 minutes in peak travel times. All of this delay is expensive: TTI estimates the cost to the region at nearly $4 billion annually (2007), and the Metropolitan Planning Council recently released a study showing even higher costs (MPC 2008). As bad as congestion is across the region, it could be worse. TTI reported that if public transportation service were discontinued, the annual hours of delay would increase by 40 million hours, adding $780 million to the region's congestion cost and nearly five minutes to a peak hour trip (TTI 2007).

Public transportation systems do not have to carry large numbers of people to dramatically reduce congestion: according to Litman, on a congested highway lane carrying 2,000 vehicles an hour, a five percent reduction in vehicle volume "will typically increase travel speed by about 20 miles per hour and eliminate stop-and-go conditions" (2007). Expanding and improving the public transportation system could further reduce the number of congested hours and travel times in the region, or at least allow them to hold steady as the population increases. Attracting new users to an improved and expanded transit system will reduce congestion directly by removing those people from the roadway and indirectly since fewer vehicles on the roadway allows the remaining vehicles to move more efficiently. Even areas with little transit usage can benefit considerably from transit provision: Lo and Hall (2006) demonstrated that a strike by Los Angeles transit workers caused traffic speeds to decline by up to 20 percent and extended the rush hour duration significantly even though transit had only a 6.6 percent mode share in the region.

Reducing congestion and improving travel times can be accomplished with either rail or bus-based solutions. Winston and Langer (2004) found that "motorist and truck congestion delay declines in a city as rail transit mileage expands" while Garrett and Castelazo (2004) "found that traffic congestion growth rates declined somewhat in some U.S. cities after light rail service began." Analysis of congestion growth rates in Baltimore, Sacramento, St. Louis, and Portland showed that congestion grew at a lower rate after the completion of light rail lines in each city (all cited in Litman 2006a). Because moving people from private vehicles to rail completely removes them from the road system, increasing rail mode share will have a greater impact on congestion than increasing bus share. However, buses can also provide congestion reduction—particularly if they are have signal priority and loading areas out of the primary travel lanes. According to Rodriguez and Mojica's report, Bus Rapid Transit can transport as many passengers as most light rail lines (2008).

The better a transit system performs, the greater the reduction in congestion. Several studies have found that when transit lines parallel freeways or other major roadways, the faster the transit service, the faster the traffic speeds on the roadway (Mogridge 1990; Lewis and Williams 1999; Vuchic, 1999; cited in Litman 2007). Additional studies show that areas with good transit tend to have lower levels of congestion than areas of similar population size with little or no public transportation (Litman 2006a).

Public transportation increases walkability and bikeability

Increasing the quality of public transportation would also increase the walkability and bikeability of the region. Although some people drive private vehicles to park and ride lots, many public transportation users walk or bike to get to transit. According to Downs, “Every transit user begins and ends their trip as a pedestrian and transit is the glue in large-scale pedestrian systems” (Downs 2008). A comprehensive transit system allows people to make longer trips on foot or by bike by using the transit system for the bulk of the trip and walking or cycling on either end of the transit ride.

Development that adequately supports and encourages transit use also tends to be better for walking and cycling. According to Litman, “When pricing incentives and vehicle restrictions reduce automobile travel, a significant portion often shift to non-motorized modes [where] shorter trips (less than three miles) tend to shift entirely to non-motorized modes, and longer trips shift to combined transit and non-motorized trips” (2004). In other words, changes that may be used to decrease private vehicle usage and increase transit usage may also significantly increase walking and bicycling. This does not mean that the walkability and bikeability of the region will automatically improve, but greater participation in both activities can lead to a greater awareness of the needs of users and improved facilities may be demanded and provided.

Environment and Health

Public transportation reduces energy consumption and increases sustainability
Increasing transit mode share and ridership by expanding and enhancing the system would increase the sustainability of the region’s transportation system in three ways: by reducing greenhouse gas emissions, reducing oil and gasoline consumption, and shifting some petroleum usage to electricity.

According to Davis and Hale, “One of the most significant actions that household members can take to reduce their carbon footprint is to use public transportation where it is available. […]Reducing the daily use of one low occupancy vehicle and using public transit can reduce a household’s carbon footprint between 25-30%” (2007). Transportation is one of the largest single sources of greenhouse gas emissions for most Americans, and is also one of the areas in which a shift to transit can have one of the greatest impacts. A single commuter changing from solo driving to public transit can reduce their daily CO_2 emissions by 20 pounds or more than 4,800 pounds a year (Davis, Todd and Monica Hale 2007).

A significant portion of the region’s public transportation vehicles run on electricity rather than petroleum products; this includes all of the CTA’s trains as well as one of Metra’s commuter rail lines. While public transportation as a whole is more than twice as energy efficient as private vehicles, electric railways are about six times as efficient (Weyrich and Lind 2003). While electricity generation has immense environmental impacts, particularly burning coal, the potential exists to significantly clean up the industry. Increasing amounts of electricity are being generated from alternative sources such as wind and solar power. As more of these sources become available and cost-effective, electricity used by the transit system will be increasingly clean. Forthcoming papers on alternative fuels and energy address these topics in more detail.

Even before the recent sharp increase in oil prices, oil security and energy independence were increasingly in the public eye. The United States imported approximately 60 percent of its oil in 2007 (EIA 2008a), and concerns over instability in oil producing nations prompted calls for increased conservation and energy efficiency (Potter 2005). The volatility of oil and retail gasoline prices in 2008 has added to that chorus (NYT 2008).

According to a study commissioned by APTA, public transportation uses about half as much fuel per passenger mile as a private automobile, sport utility vehicle (SUV), or light truck. In 1999, this translated into a national savings of nearly 890 million gallons of gasoline or nearly 47 million barrels of oil. These savings were achieved despite the fact that public transportation accounted for only 1.1 percent of all trips made in the United States that year (Shapiro, Hassett, and Arnold 2002). More recent analysis conservatively estimated that public transit usage saves the United Sates at least 1.4 billion gallons of gasoline a year (Bailey 2007). Another study concluded that rail travel consumes approximately one-fifth of the energy per passenger mile as a single-occupancy vehicle (Litman 2006a).

These savings represent a significant amount of oil that does not need to be imported into the United States, even if it is only a small portion of total consumption. Additionally, with oil hitting an inflation-adjusted record price in 2008, the financial savings provided by transit are increasingly significant. (EIA 2008b)

As noted above, public transportation uses about half as much fuel per passenger mile as private vehicles. In addition to fuel savings accrued from shifting drivers to transit, there would be savings for those continuing to drive. Congested traffic conditions do not allow vehicles to run efficiently: De Vlieger, De Keukeleere, and Kretzschmar found that vehicles used 20 – 45% more fuel during congested rush hour traffic than during less congested hours of the day (2000). As private vehicle users shift to public transportation, congestion should lessen somewhat, allowing traffic to flow at smoother speeds, and vehicles to run more efficiently and use less fuel. Shifting even a relatively small number of users from private vehicles to public transportation could have notable effects on traffic congestion, which in turn would serve to lower emissions and improve local air quality. It is estimated (Litman 2006a) that each 1% reduction in VMT results in 2-3% reduction in emissions.

Public transportation improves air quality

Shapiro, Hassett, and Arnold found that public transportation provides significant environmental benefits over private vehicles:

> Travel by public transportation produces, on average, 95 percent less carbon monoxide, 90 percent less volatile organic compounds, and about 45 percent less carbon dioxide and nitrogen oxide, per passenger mile, as travel by private vehicles. These reductions implicitly saved between $130 million and $200 million in regulatory costs based on prices for reducing nitrous oxides and volatile organic compounds (2002).

Shifting trips from private vehicles to public transportation will decrease the region's air pollution and increase the overall ambient air quality. According to Shapiro, Hassett and Arnold (2002), "Given its high energy efficiency and low polluting, public transportation offers the single largest untapped source of energy savings and environmental gains available to the United States." These improvements come about through two steps. First, as the transit system is improved and more people use transit instead of personal vehicles, their individual emissions drop. Second, air quality improves as people shift to public transportation and congestion on roadways decreases; this relationship has already been discussed in the energy section.

Public transportation improves health and safety

According to Litman, transportation planning decisions impact public health and safety through their effects on crashes, vehicle pollution and physical activity; of the ten leading causes of death in the United States, at least seven can be linked to these causes (2006b). More specifically, motor vehicle crashes are the third leading cause of potential years of life lost in the United States (CDC 2003 cited in Litman 2006b); IL Dept of Public Health shows motor vehicle crashes as the 2nd leading cause of death for Illinoisans under age 45 in 2006 (ILDPH, 2008). Increasing public transportation ridership can help reduce these negative effects. Cities with major rail transit systems experience 36% fewer per capita traffic fatalities (Litman 2006a).

Increasing transit ridership may decrease fatalities and injuries from traffic collisions. According to Litman, "Per capita traffic fatalities tend to decline with increased per capita transit ridership" (2006b). According to the same report, transit users have about one-tenth the crash fatality rate as private vehicle users, and most of these fatalities are people struck by transit vehicles, not to transit users themselves. Additionally, shifting users to transit reduces total vehicle traffic which has the benefit of reducing risk to other road users (Litman 2006b).

In a study examining the relationship of health care costs and levels of air pollution, Fuchs and Frank found that areas with higher levels of air pollution have statistically significant higher levels of health care usage and related costs. More specifically, the "use of medical care is significantly higher in areas with more pollution and that decreased use of care is an important potential benefit from pollution control" (2002). As previously cited, shifting users from private vehicles to public transportation can reduce air pollution which in turn can lead to lower levels of heath care utilization and lower levels of heath care expenses.

Another important gain in shifting users from private vehicles to public transportation is that users are more likely to participate in active transportation such as walking and cycling and lead more physically active lifestyles. Analysis of the National Household Transit Survey "found that Americans who use public transit on a particular day spend a median of 19 daily minutes walking to and from transit, and 29% achieve 30 minutes of physical activity during transit access trips" (Cited in Litman 2006b). Frank, et al found that a 5% increase in the walkability index of neighborhoods in King County, Washington, "is associated with a 32.1% increase in time spent in active transport (walking and cycling), a 0.23 point reduction in body mass index, a 6.5% reduction in VMT, and similar reductions in air pollution emissions" (2006). Transit friendly neighborhoods tend to be more walkable, and transit usage often leads to increased walking over private vehicle usage as people walk to and from stations. This increased walkability has clear public health benefits. Expanding the public transportation system and the share of people using it can work to reduce obesity and other health issues.

Land Use and Housing

Public transportation increases nearby land value

Numerous studies show that proximity to public transportation, particularly fixed rail lines, generally increases land values and brings added value to current land owners (Diaz 1999).

Studies of land values prior to and following the construction of the Orange Line "El" in Chicago showed nearly a seven percent higher appreciation rate for homes within 1.5 miles of the line than homes not within this distance between 1986 and 1999; this works out to approximately $6,000 more per home (McMillen and McDonald 2004). Another study of the same line demonstrated that land values rose in anticipation of new transit service: in 1990, three years prior to the opening of the Orange Line, a 17% increase in residential land values within one half mile of new stations could be attributed to the future transit line (McDonald and Ousji 1995). Both studies also showed that the presence of transit stations had a greater positive effect on land values the farther the station was from the central business district (CBD).

Increased land values near transit stations have also been shown with Atlanta's MARTA rail system (Bowes and Ihlanfeldt 2001). Compiling numerous studies, Ryan found that both light and heavy rail transportation facilities generally have positive impacts on land values, particularly within one third of a mile of the facility (Ryan 1999).

Similar to what has been demonstrated with residential land values, Cervero and Duncan looked at the impacts of the presence of rail transit on commercial land values and found considerable premiums the closer the site was to a rail station. Their results showed increases in land values ranging from 23% for locations within walking distance of a light rail station to 120% for locations within CBDs and one quarter mile from a heavy rail station (2002).

Public transportation increases Transit Oriented Development and infill potential
With both fuel prices and congestion rising, demand for housing near transit can also be expected to increase. The Chicago region had 787,204 households living within a half mile of a fixed guideway transit stop in 2000; according to the Center for Transit Oriented Development, this number is projected to nearly double to 1,503,638 by 2030 (CTOD 2007). Expanding and enhancing the transit system will likely increase this demand. Projects that increase the interconnectedness of the transit system and make it easier to access areas other than the Loop will make transit a more appealing and more useful transportation option as will faster and more reliable bus and train service.

Transit Oriented Development (TOD) seeks to integrate land use and transportation planning by designing communities that are less automobile dependant and more conducive to public transportation use. While definitions of TOD differ from location to location, walkability and pedestrian access to public transportation is always a component of the definition (Schlossberg and Brown 2004). The Urban Design strategy paper < http://goto2040.org/urbandesign.aspx > contains a more detailed explanation of TOD and its features.

Also, transit supports infill development, as infill sites are generally in older areas that have access to transit. TOD that occurs in infill areas generally has fewer environmental impacts than greenfield development. For additional information on the benefits of redevelopment, see CMAP's Brownfields Strategy Paper and Infill Snapshot.

Evanston provides a strong example of how the existence of a well developed transit system combined with planning designed to encourage infill development can attract significant investment and new development. Beginning with a 1986 comprehensive plan, Evanston focused on promoting dense infill development along Chicago Avenue, near four rail stations that are served by CTA bus and rail, Metra rail (at two of the stations), and Pace buses. The city performed a detailed analysis of existing conditions in the area including housing, commercial and retail development, traffic patterns, and parking demand. This analysis was coupled with citizen and business owner input in developing a plan to encourage denser residential, commercial, and retail development within close proximity of the rail stations (Makarewicz, Benedict, and Marshall 2006).

The city took two distinct steps to set redevelopment in motion: it rezoned the land in the corridor to allow denser and taller development while also reducing the parking requirements, and it invested significant public funds in the corridor in the form of utilities and parking facilities, while also securing significant upgrades to the transit system from the service providers. These public investments spurred significant private investment and by 2005, nearly 2,500 new residences had been built, the number of businesses increased significantly, commercial vacancy rates decreased, and retail sales increased. Significantly, Evanston's total equalized assessed value increased 191 percent during the period, allowing the city to lower its property tax rate to the lowest level since 1971 (Makarewicz, Benedict, and Marshall 2006).

Very little of this development would have been possible without a vibrant public transportation system in place. Easy access to the El, commuter rail, and Chicago and suburban buses allow residents, employees, and shoppers to traverse the area easily without the costly need for private vehicles. Additionally, comprehensive transit service allowed Evanston to promote significantly denser development without heavily taxing its roadways. The authors of the case study conclude:

> By creatively redeveloping underdeveloped, vacant, or deteriorated buildings and previously overlooked parcels in transit served areas, Evanston's rapid residential, entertainment, and office build out has provided more revenue streams to the city and additional entertainment, shopping, and work destinations for the northern portion of the Chicago region without adding substantially more auto traffic (Makarewicz, Benedict, and Marshall 2006).

New transit service, particularly rail, can also spur redevelopment and investment: a new light rail line in Jersey City and Hoboken, New Jersey, has stimulated significant investment and redevelopment in the neighborhoods it serves. First opened in 2000, the main line of the light rail traversed numerous brownfields, industrial sites, and underutilized land; a second line opened in 2006 and served similar land uses. In conjunction with the building of the rail line, both Jersey City and Hoboken modified their zoning to reduce parking requirements, allow for mixed use development, and allow for greater density. These changes brought significant investment to the corridor, and over 4,500 new housing units were constructed between 2000 and 2005. Significant amounts of new retail and commercial space have also been built within the transit corridor. According to Robert Cotter, planning director for Jersey City, "rail is what makes these projects go…it gives investors the confidence that is needed, because it can't be taken away like a bus line" (quoted in Wells and Robins 2006). The authors of the case study highlight that the connectivity of the new rail service (it connects to numerous rail, bus, and ferry services serving New York City) further enhanced the ability of the line to attract development (Wells and Robins 2006).

These case studies highlight the strong impact that public transportation service, particularly rail service, can have on attracting investment and redevelopment to underutilized areas. Expanding and enhancing the region's transit system will provide more of these opportunities and allow municipalities to tie changes in their zoning and land use policies to improvements in the transit system.

Public transportation affects housing affordability

The expected increase in demand for transit oriented housing in the Chicago region between now and 2030 will require new efforts to increase the supply of housing in these areas. The housing stock available near transit stops can be increased to meet this demand by expanding the existing transit network, thereby increasing the supply of housing, both existing and potential, that can be located near transit stops. The housing supply can be increased even further by coupling the expansion of the existing transit network with the planning of surrounding neighborhoods. For example, Transit Oriented Development could be used to encourage the development of high-density housing, retail, and commercial developments. These developments would increase both the stock of housing and the number of amenities available in the area.

While the rising property values associated with demand for these transit oriented areas are generally desirable, gentrification and the loss of affordable housing are concerning. Adding to the other studies, Lin found that properties in Chicago closest to transit "experienced significant gains in property value change versus properties located farther from transit" and that transit access spurred gentrification in northwest Chicago (Lin 2002). Higher housing costs in these areas may be justified to some residents by the transportation cost savings that can be generated through increased access to public transit systems. However, this argument does not apply to all residents living near a transit station. Indeed, some "low-income households can no longer afford the rising housing costs near some rail stations, forcing them to move to areas with less transit accessibility" (Pucher and Renne 2003).

Expanding the public transportation system, particularly rail lines, can have a positive effect on land values while also presenting nearby landowners with increased travel options for themselves, employees, or customers. These positive benefits should be highlighted when system expansions are undertaken. At the same time, it is imperative that affordable housing is preserved so that low and moderate income residents are not priced out of their neighborhoods when expansions occur. See the Housing Preservation Strategy report <http://goto2040.org/ideazone/forum.aspx?id=822> for more information.

Economy

Public transportation helps to retain and attract employment

The region's public transportation system is a major source of jobs through direct employment and indirect employment for construction of capital projects. An expanded public transportation system would create numerous new jobs for the region.

Looking at three separate scenarios, Chicago Metropolis 2020 found that expanding the public transit system would offer numerous job opportunities. The first scenario was designed to maintain the current level of transit service and resulted in the creation of 11,395 new jobs by 2020. A second scenario examined expanding the current system, and projected 16,855 new jobs. The third scenario coupled the expanded transit system from the second scenario with land-use planning focused on increasing transit usage, and resulted in the creation of 22,307 new jobs by 2020 (Chicago Metropolis 2020 2007b).

In addition to the jobs directly created by expanding the public transportation system, an extensive and expanded system attracts new businesses to the region. Chicago Metropolis 2020 suggests that increasing and expanding the public transit system can attract jobs "generated by a healthier economy, and by the Chicago region's success in global competition for jobs and prosperity" (Chicago Metropolis 2020 2007b). The report found that increasing and expanding Chicago's public transit system is imperative to the region's future as a global metropolis. Without these much needed improvements, the region will lose jobs to metropolitan areas with more advanced transit systems.

Transit advocates highlight the positive benefits that a strong and vibrant public transportation system brings to the region. Nelson et al found that rail transit in the Washington D.C. region generated congestion-reduction benefits that exceeded the cost of rail subsidies and that the overall benefits of the bus and rail system in the region greatly exceeded the costs of the system (2007). As mentioned previously, Chicago Metropolis 2020 found that simple maintenance of the current transit system would provide a 21% return on investment, while greater levels of funding could return up to 34% or as much as 61% if the funding was tied to land use policies that encourage transit use (2007). Essentially, the more money that is put into the public transportation system, the greater the potential return on investment for the region.

Public transportation reduces household expenditures
Private vehicle ownership and usage is expensive: for 2008, the American Automobile Association estimates the average cost of car ownership is $5,576 annually with additional operating costs of $0.17 per mile (using an average gas price of $2.941 per gallon). For someone driving 15,000 miles a year, this equals $8,121 per year in total costs (AAA 2008). Americans spend more on transportation than any other good except housing (BLS 2007).

Public transportation can reduce this expense. According to the Bureau of Transportation Statistics, people using public transportation spend approximately 40 percent less than those commuting by private vehicle, just for the commute (BTS 2003 cited in Bailey 2007). Modeling for a "transit household" (two adults, one private vehicle, transit users) compared to a "non-transit household" (two adults, two private vehicles, no transit use) showed that the transit household would save $6,251 annually relative to the non-transit household, even when accounting for transit fares (Bailey 2007).

Conclusion

The Chicago metropolitan region is served by an extensive and well developed public transportation system. The region's three service providers offer regular service that is accessible to much of the region and provides numerous benefits to people who use the system, as well as those who do not. However, despite numerous innovative efforts to improve the connectivity, usefulness, and convenience of the system, system wide ridership in 2007 was nearly 25% below 1980 ridership levels in total ride volume, and was considerably lower when considered from a mode share perspective (RTAMS 2008a).

Expanding and enhancing the public transportation system and doubling the transit mode share would have numerous positive outcomes for the region. From a housing and land use perspective, this expansion and increase in ridership would increase both the demand and supply of transit accessible housing, increase housing and land values, and promote redevelopment and infill development. Environmentally, this change would improve air quality while reducing oil consumption. Traffic congestion and travel times would improve, or at least hold steady as the region's population increases. Traffic related deaths and injuries should also decrease. Such a transit expansion would also benefit the region economically, as the expansion itself would create numerous jobs while the improved system would make the region even more attractive to employers.

One of the central pieces of the *GO TO 2040* plan will be its approach to public transportation. The strategies in this paper describe a variety of system-wide improvements that could be considered in the plan, or in some cases are already underway. CMAP welcomes comments on additional approaches that should be considered in *GO TO 2040*, or corrections to the information contained in this paper.

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