Results of "preserve" scenario travel modeling

Introduction and purpose

The *GO TO 2040* plan, due to be complete in 2010, will make recommendations for policies, strategies, and investments in transportation and other fields. This document is part of a series that begins to examine potential plan recommendations by testing the effectiveness of "sample programs" of systematic improvements of different types.

In this case, a sample program for transportation management and operations was developed that is consistent with the theme of the preserve scenario and a "Complete Streets" planning approach. It assumes that the region invests heavily in our current transportation assets and that forecast growth and development can be accommodated by devoting transportation funds primarily to improving the performance of existing facilities. Each of the alternative regional planning scenarios uses a different balance of capital and non-capital investment, and this scenario minimizes investment in new transportation capital facilities.

Before reviewing the remainder of this document, please read the following notes, which explain its purpose and limitations:

- Implementation: This document does not address the responsibility for implementing the sample programs described here. This is very important consideration and will be addressed as a next step.
- Scenario context: In reality, transportation management and operations will not be pursued in the absence of other strategies. CMAP recognizes that the benefits of the strategy are magnified when linked with compatible land use measures. As a later step, transportation management and operations will be analyzed along with other strategies; but for this series of documents, CMAP is attempting to isolate and examine the benefits of the transportation components of each scenario.
- Specificity: The results of the analysis are not accurate at the individual facility level and further geographic detail beyond what is shown in this document cannot be given.
- Assumptions: To perform the analysis of the sample program described here, assumptions were made for appropriate locations for improvements and their effects. The purpose of the document is to allow these assumptions to be discussed and questioned.

The purpose of the analysis and modeling exercise is to determine, on a regional scale, where and to what degree transportation management and operations strategies should be applied, how much such a program would cost, and how it will impact key indicators.

Key assumptions

Any regional analysis and modeling process involves making assumptions. The fundamental assumptions for the transportation management operations strategies associated with the preserve scenario involve the following:

- The definition of transportation management and operations strategies;

- The method for determining locations for improvements to be made; and
- The transportation impacts and fiscal impacts of implementing the strategies.

The assumptions within each of these stages of analysis will be fleshed out in greater detail below.

Definition and benefits of transportation management and operations strategies

For the purposes of this paper's analysis, transportation management and operations strategies can be implemented as if selecting from a menu. One strategy could increase operating frequency while another could increase operating speeds. For the purpose of this analysis, we consider two types of transportation management and operations strategies: system management and demand management. Demand management refers to policy actions that affect traveler behavior and choice. System management refers to policy actions that affect how infrastructure is operated and how services are provided.

These actions are often divided by travel mode to represent where the strategy action is directed. The strategies described in this document include:

Demand Management

- Transportation demand management (1)
- Parking policy (2)
- Car-sharing (3)

System Management

- Pedestrian and bicycle improvements (4)
- Transit system operations, including service extensions (5), headway reduction (6), and expanded paratransit (7)
- Highway system operations, including access management and increased intersection efficiency (8)

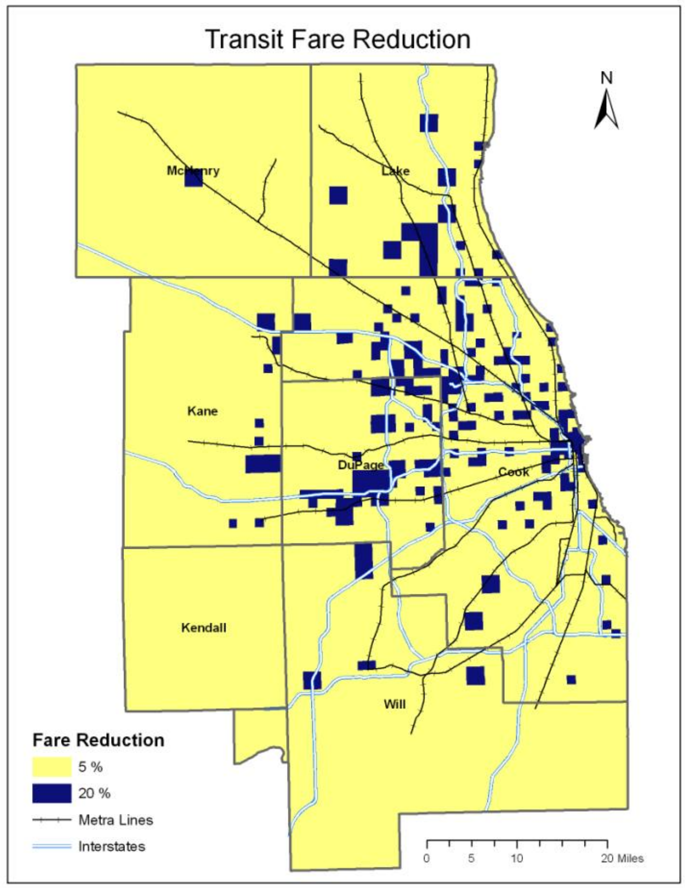
1. Transportation demand management

Transportation Demand Management (TDM) is a strategy to reduce demand for single occupancy vehicle use on the regional transportation network. A paper describing TDM strategies is available online at: http://www.goto2040.org/ideazone/default.aspx?id=6136.

TDM is often defined broadly, and in the strategy paper includes four elements: traveler information, employer and campus TDM, auxiliary transit services, and market and financial incentives. Three other elements, including parking policy, bicycling and walking strategies, and managed lanes, are also sometimes included in definitions of TDM. All of these elements are important, and are included somewhere in the scenario process; many of them are described in more detail later in this report. However, for modeling purposes, this definition is too broad. For example, parking policy, car-sharing, and bicycling and walking are major transportation strategies that deserve to be evaluated in their own right, rather than grouped into a larger TDM program.

Therefore, for modeling purposes, a more narrow definition of TDM is used. Based on available research, a set of TDM strategies can be expected to reduce the actual or perceived "cost" of using transit. (In modeling terms, the "cost" of traveling includes both the financial cost and the time spent waiting and traveling.) Reducing cost is typically accomplished through better information and individualized marketing, support services such as "guaranteed ride home" programs, employer encouragement of transit use, or financial incentives including pre-tax transit benefits. All of these programs have positive impacts on the use of public transit.

Experience locally and in other parts of the country has shown that TDM programs are especially effective when employers are involved. Within this region, the Lake-Cook TMA and Prairie Stone TMA are examples of this. The transit mode shares to locations covered by these TMAs are 14% and 19%, respectively. In comparison, employment centers in Oak Brook and along the I-88 corridor through Warrenville, Naperville, and Aurora, which have similar overall characteristics but no organized TMAs, have transit mode shares of only 10-11%.



The TDM strategy was applied across the region at two levels. First, major suburban employment centers (identified by density of employment) were assumed to form TMAs, making TDM strategies more effective. The cost of home-to-work transit trips to these locations was reduced by 20% to reflect the effectiveness of these TMAs in increasing transit mode share. The cost of home-to-work transit trips to all other locations in the region was reduced by 5%, showing some benefit but not as much as in the areas where extensive employer involvement is assumed.

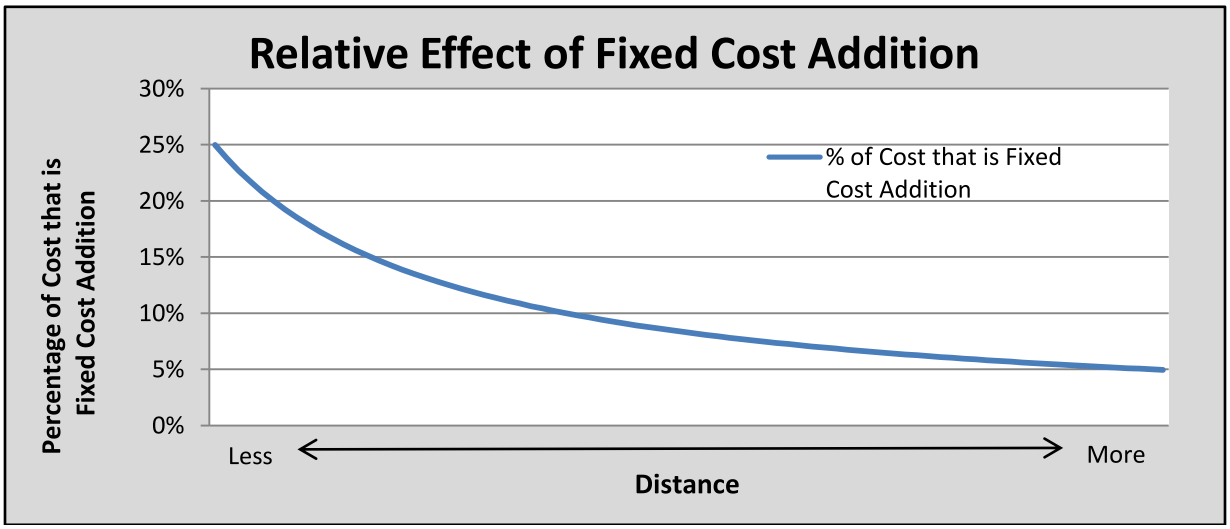
The costs of implementing this program are minimal from a long-range planning perspective.

2. Parking policy

The major reference for the parking policy assumptions included in this section was a 2003 report by the Transit Cooperative Research Program (TCRP), "Parking Management and

Supply," online at: http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_rpt_95c18.pdf. CMAP is preparing a strategy report on parking but this has not yet been completed.

The TCRP report examines parking supply management strategies including minimum or maximum parking requirements, employer-based parking management, on-street or residential parking, and remote park-and-ride facilities. It demonstrates strong links between parking policy and travel behavior, particularly the use of alternative transportation modes. For example, vehicle trips were shown to be reduced by approximately 20% when parking at a location was scarce rather than unrestricted. Pricing was also demonstrated to have a major impact, with nominal pricing shown to reduce vehicle trips by 10%, and market-rate pricing shown to reduce trips by an additional 15% beyond this (p. 22). However, alternative transportation options must be available to accommodate these trips.



For modeling purposes, new parking policies designed to reduce automobile trips and encourage alternative transportation were assumed to be implemented regionwide. In modeling terms, this was done by increasing the "fixed cost" of arriving at one's destination by auto by an average of 25 percent. (Costs are divided into two types: variable costs, which increase with distance, and fixed costs, which do not. For most trips, variable costs significantly exceed fixed costs.)

The new parking policies described above include nominal pricing and reducing minimum parking requirements below conventional standards. Both of these are assumed to add "cost" to the trip, either in terms of an actual fee, or additional time required to walk from a more distant parking spot. More advanced parking pricing strategies, such as charging market rates or using variable pricing, are also worth exploring, but these are more consistent with the themes of the "innovate" scenario and will be included in that analysis instead.

Unlike most strategies, parking policy changes can generate revenue and have little public sector cost. Work on the financial implications of this strategy is still underway.

While this document does not generally address implementation, there are particular concerns with the implementation of this strategy that should be brought up. The full effectiveness of parking policies at encouraging the use of alternative modes will only be realized if these policies are adopted regionally; otherwise there may be diversion of automobile trips to locations that have not adopted these policies.

3. Car-sharing

Car-sharing programs allow groups of individuals or organizations to share the cost of car ownership. A paper describing car-sharing programs is available online: http://www.goto2040.org/carsharing.aspx.

According to studies of car-sharing cited in the above report, each car-sharing vehicle replaces approximately 15 privately-owned vehicles. Two companies, Zipcar and I-Go, currently operate car-sharing programs in the region, with a combined fleet of around 500 vehicles. Car-sharing locations are primarily within the denser parts of the region, where demand for these programs has been highest.

To evaluate this strategy, a dramatic expansion in geography and participation was assumed to occur. The number of participants and vehicles was assumed to increase tenfold (while this is a major increase, this would still cover only about 2% of the region's residents). For modeling purposes, the effect of car-sharing was estimated by reducing the total vehicle miles traveled in the region to reflect the removal of approximately 75,000 automobiles.

Car-sharing has its greatest positive impact on individual transportation expenditures rather than regional travel behavior. Therefore, even though this strategy was evaluated using the travel demand model, the financial benefit to individuals would need to be calculated outside of the model.

Car-sharing programs are operated by private companies and no public cost in their expansion was assumed. Public funds have been used in the region in the past to support the initiation of a car-sharing program, but as use of car-sharing grows, public subsidies are assumed to become unnecessary. The financial benefits of car-sharing accrue to households or businesses, not the public sector, so car-sharing is not assumed to create any public revenue either.

4. Pedestrian and bicycle improvements

One of the central features of the "preserve" scenario is the improvement of the pedestrian and bicycle environment across the region. CMAP has released many reports on this subject, available on the bicycle and pedestrian program website, http://www.cmap.illinois.gov/bikeped/bikeped.aspx. Specific reports for *GO TO 2040* on these subjects include one on bicycling (http://www.goto2040.org/bicycling.aspx) and one on urban design and walkability (http://www.goto2040.org/urbandesign.aspx).

Within the travel model, pedestrian and bicycle trips are addressed through the use of Pedestrian Environment Factor (PEF). (Even though the acronym only specifies that pedestrians are considered, our use of the term includes bicyclists as well.) Each subzone in the region has a PEF score, which ranges from 0 to approximately 80.

The PEF determines the likelihood that a trip of a certain distance originating or ending in that zone would use a nonmotorized travel means (i.e. walking or biking). Among trips of the same length, the higher the PEF, the greater the likelihood is that a trip would be nonmotorized. The use of nonmotorized travel means is greatly influenced by trip length; shorter trips are much more likely to be made by walking or biking than longer ones. For example, for a ½-mile trip beginning and ending in a subzone with PEF of 10, there is a 53% probability that the trip will be nonmotorized; for a similar trip in a subzone with a PEF of 80, the probability is 72%.

Subzones with higher PEF also have a greater likelihood of transit use, reflected in the model by increasing the "catchment area" of transit services, to reflect the fact that transit trips begin and end with walking trips.

Pedestrian and bicycle improvements were reflected in the travel model by increasing PEF. This was done in a systematic way through a number of steps. Three steps led to significant increases in PEF:

- The overall bicycling environment in the region was assumed to be improved through education of bicyclists and motorists, enforcement, plentiful bicycle racks, overall policy support for "Complete Streets," and similar low-capital activities, as well as a similar low-capital approach to pedestrian travel. In modeling terms, the effect of these policies was shown by increasing PEF by a small amount regionwide.
- The Strategic Regional Bicycle and Pedestrian System, as currently adopted, was assumed to be implemented. This is an inventory of local and sub-regional bicycle plans as well as the greenways and trails plan. PEF was increased according to the mileage of new planned facilities within or nearby each subzone.
- Growth and land use change provides an opportunity to increase PEF through design that incorporates the needs of pedestrians and bicyclists. PEF was assumed to increase proportionally to new growth occurring in each subzone. This is assumed to be accomplished primarily through sidewalk construction and intersection improvements, including retiming for pedestrian access and physical redesign.

A few other steps led to minor increases in PEF:

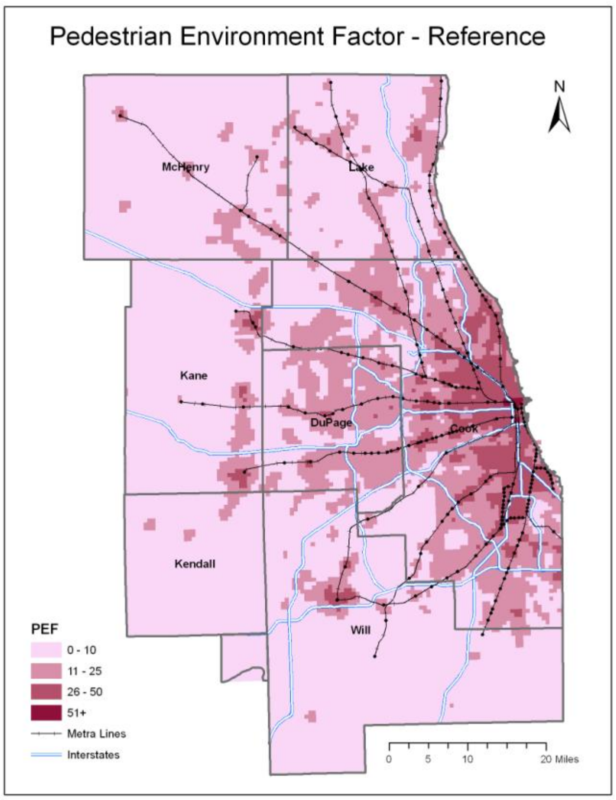
- Areas that are currently developed but without high growth forecasts were assumed to be retrofitted, if necessary, to provide pedestrian and bicycle access. Most of these areas already had high PEFs, and this step had minimal impact.
- When subzones passed a certain threshold (200 households per subzone) their PEF was increased to a base level to acknowledge the presence of basic pedestrian infrastructure in these places. This also had minimal impact, as the PEF was already above the base level in most of these subzones.

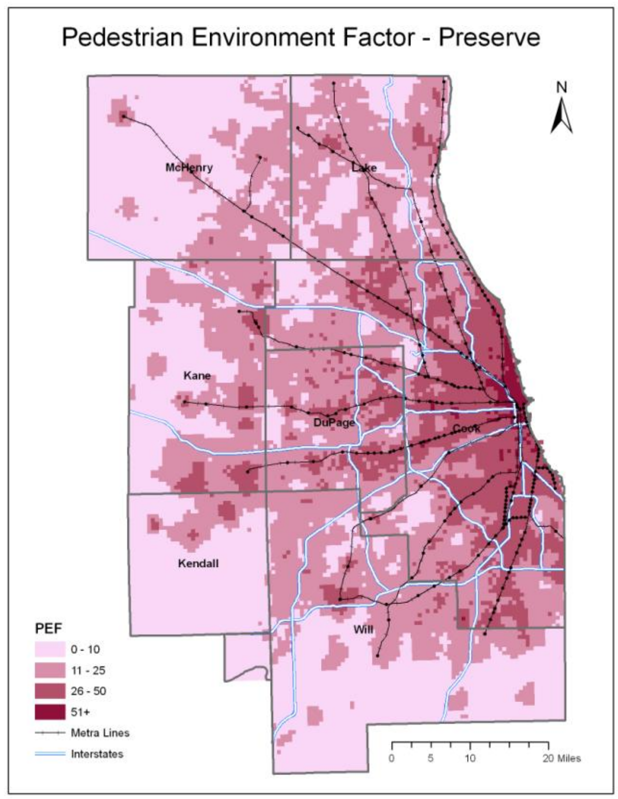
Two additional steps that would increase PEF have been conceptualized but not yet evaluated:

- Pedestrian-related large capital improvements. These have not yet been included. If they are, it would be assumed that the current rate of construction of pedestrian and bicycle bridges and tunnels (from the TIP) would continue and be somewhat increased between now and 2040. Because it is not possible to predict exactly where these facilities will be built far into the future, it will probably be assumed that they will be distributed around the region by population density or a similar measure.

- Urban design features will also increase PEF but are not fully included in this analysis. Application of urban design features, which include changes in land use, site layout, building aesthetics, and others, are being analyzed as part of the urban design strategy. When this is complete, additional increases in PEF to reflect these urban design improvements will occur beyond what is covered here.

The change in PEF that these steps created is shown in the maps below.





Each step described above has its own set of implementation costs. These are described below.

- Overall policy support for "Complete Streets" does not have significant cost. The education and enforcement programs described above are assumed to cost approximately $1 million per year, based on experience from other regions that have done region-wide projects of this type. This amount is not significant in the 30-year cost estimates. The installation cost of bicycle racks is also assumed to be fairly low and is not specifically calculated.

- The implementation of the Strategic Regional Bicycle and Pedestrian System would involve the addition of approximately 3,500 on-street and 4,000 off-street miles. Estimated unit costs for the construction of these are $40,000 per mile for on-street and

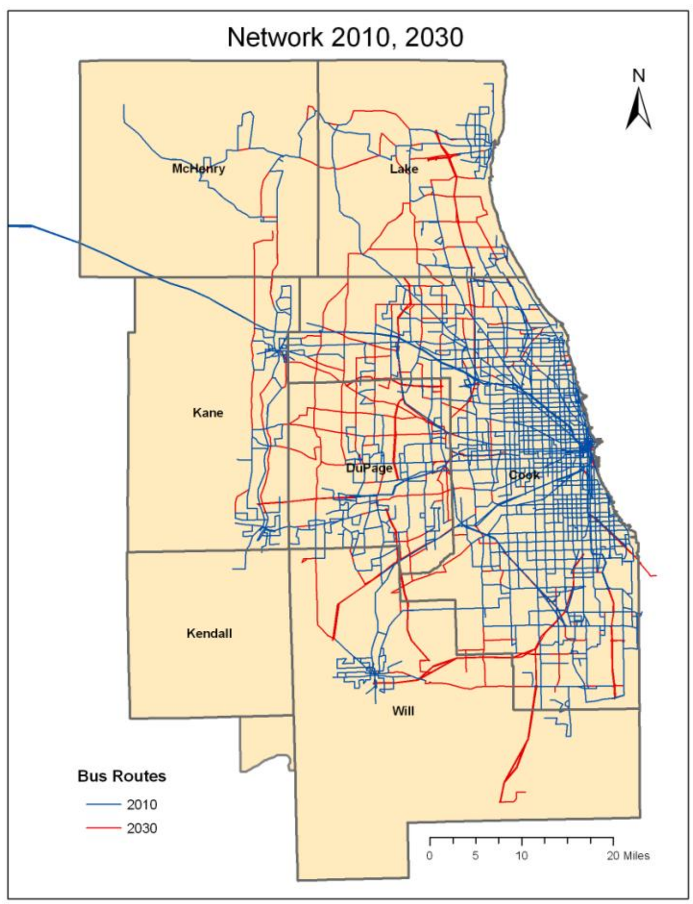
$850,000 per mile for off-street facilities. This yields an estimate of $3.5 billion for the build-out of this system, or approximately $120 million per year for 30 years.

- The sidewalk construction and intersection improvement activities would also require capital expenditure. A portion of this could be assumed to be covered by the construction of sidewalks as part of new development, which is often required to be done by the developer. However, some sidewalk retrofits and intersection improvements would be the public sector's responsibility. The costs for this have not yet been determined, but work on this is underway.

5. Transit system operations: service extensions

Transit system operations will be improved in several ways in the "preserve" scenario. A forthcoming strategy paper will provide more background on some of these; in the meantime, the RTA's Moving Beyond Congestion report, online at http://movingbeyondcongestion.com/, identifies a number of service enhancements that include these operational improvements.

The first of these involves low-capital transit service extensions. This included bus extensions planned by Pace and CTA; rail extensions were not included because their significant capital requirements did not match this scenario's focus on low-capital, operational improvements. For this purpose, the future transit networks that had previously been developed for the scenario planning portion of the 2030 RTP were used.



These extensions brought transit access to previously unserved parts of the region. Using a ½-mile buffer as the standard for calculating transit access, this increased the area within the region that has transit access by approximately 27% (in terms of land area). Because the areas were service was extended are generally less dense than those where service already exists, this had a smaller impact on people and jobs served; this strategy increased the number of households within ½ mile of transit from 2.8 million to 3.1 million, and increased the number of jobs within ½ mile of transit from 4.5 million to 5.2 million.

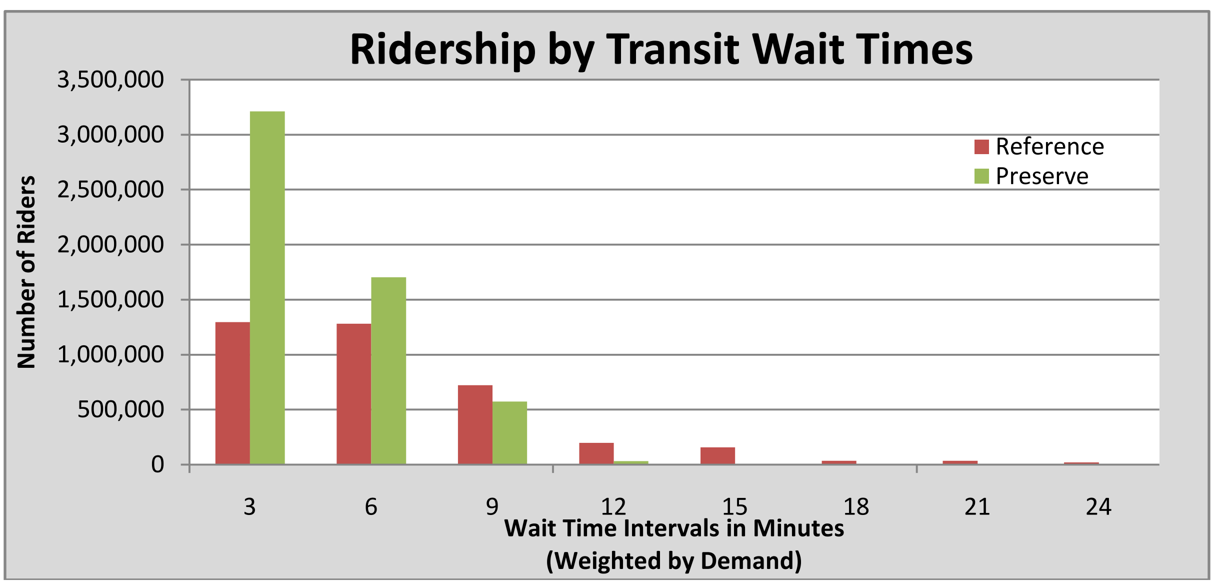
These extensions increased the service hours for public transit by approximately 19% (from 3,787 service hours during the 2-hour am peak to 4,520 hours). Initial estimates indicate that this translates to an additional cost in the area of $65-$100 million per year.

6. Transit system operations: wait time reductions

A second operational improvement reduces wait times on existing transit services, making transit a more attractive mode of travel. (Please note that this identical strategy is also included in the "reinvest" scenario.)

This was reflected, in the transportation model, by cutting the average wait times for transit in half. Time spent waiting for transit is seen as more onerous than time spent on the vehicle, so reducing wait times will increase the attractiveness of transit even if in-vehicle time is unchanged. In the transportation model, before "deciding" what mode of travel to use, travelers consider the cost (including time) of each mode, so these wait time reductions will attract more riders to the transit system.

A reduction in wait times could be accomplished through a number of means. The frequency of service could be increased, shortening headways. Technological improvements such as traveler information can also reduce wait times by simply making arrival information available, and this strategy is explored further in the ITS-focused "innovate" scenario. Transit agencies also can (and do) make operational improvements to account for changing ridership and traffic patterns and improve schedule adherence; this can involve schedule modifications, route realignments, improvement of timed transfers, or larger restructurings (such as Pace's ongoing restricting initiatives described at http://www.pacebus.com/sub/initiatives/st_default.asp). Wait times can also be reduced without requiring major capital investment by policy changes that improve schedule adherence (such as reducing "bus bunching" by having mobile bus supervisors) and technological improvements. This strategy assumes that a combination of these methods will be used to achieve an average wait time reduction of 50%.



As with all of these strategies, this analysis was done to illustrate the effect of a systematic improvement. It did not consider the capacity of facilities to physically accommodate additional transit vehicles or reduced wait times. This is obviously a concern that would need to be addressed in detail if this strategy were to be pursued.

Among the means of reducing wait times described above, the only one that involves significant additional cost is adding vehicles to reduce headways. The other improvements (operational adjustments and policy changes) can actually reduce costs for transit agencies; for our purposes we simply assumed that costs and savings were approximately equal. As a starting point, the headway reductions were assumed to increase the service hours for transit vehicles by 25%. Further assistance from transit service boards will be needed to validate this assumption and assist with the estimation of potential costs.

7. Transit system operations: paratransit

Paratransit service is not addressed in the transportation model, but is an important part of the transportation system and is directly relevant to the concept of the "preserve" scenario. This strategy was therefore examined outside of the context of the transportation model.

For this discussion, paratransit service is divided into two parts. The first involves service required by the Americans with Disabilities Act (ADA) to be provided in any location that has fixed-route transit service. Any ADA-eligible individual who is unable to use fixed-route transit, but who is making a trip within ¾-mile of existing fixed-route service and within the hours of operation of that service, must be accommodated on paratransit. Pace provides this service for the entire region, including within Chicago.

Paratransit service offered by Pace in compliance with ADA requirements is estimated to cost approximately $100 million in 2009. Even without any additional service, the demand for paratransit service is likely to rise by 2040. Initial CMAP projections estimate that the number of elderly people (over 65) in the region will double by 2040, and the number of very old people (over 85) will more than triple. Elderly people are more likely than younger people to have disabilities that make them ADA-eligible, so this is an indication that the number of ADA-eligible residents will rise dramatically by 2040.

The second type of paratransit involves service offered beyond the requirements of ADA. Many townships or municipalities offer limited service to elderly or disabled residents, either through publicly operated programs or through vouchers for taxi service, for example. Several coordinated services, which cross jurisdictional boundaries, exist; the best examples of these are the Ride DuPage and the Ride-in-Kane programs, which are funded by a number of organizations (including Pace, who typically operates the service) and provide extensive options for travelers in terms of hours of operation, destination, and trip purpose. These programs are generally limited to elderly, disabled, or lower-income residents, but the threshold for eligibility is lower than the ADA standards.

This strategy involves the expansion of paratransit service of the second type, while also assuming that ADA requirements will continue to be met. Ride DuPage and Ride-in-Kane were used as models for how a coordinated paratransit service, partially funded by local governments, might be expanded to include all areas in the region. The cost of implementing Ride DuPage or Ride-in-Kane type services that cover the remainder of the region (excluding Chicago) is currently being estimated.

The benefits of paratransit are difficult to express in similar terms to other transportation strategies. Because the number of riders is low in comparison to the entire transportation system, paratransit service expansion has little to no measurable impact on mode share, congestion, air quality, or other measures that can be calculated using a transportation model. However, it does provide very important travel options for people who have limited mobility, who otherwise may have been unable to get to work, medical appointments, or shopping. It therefore makes more sense to discuss the benefits of paratransit in terms of its improvement to overall health or quality of life for the individuals who use it.

8. Highway system operations: access management and increased intersection efficiency

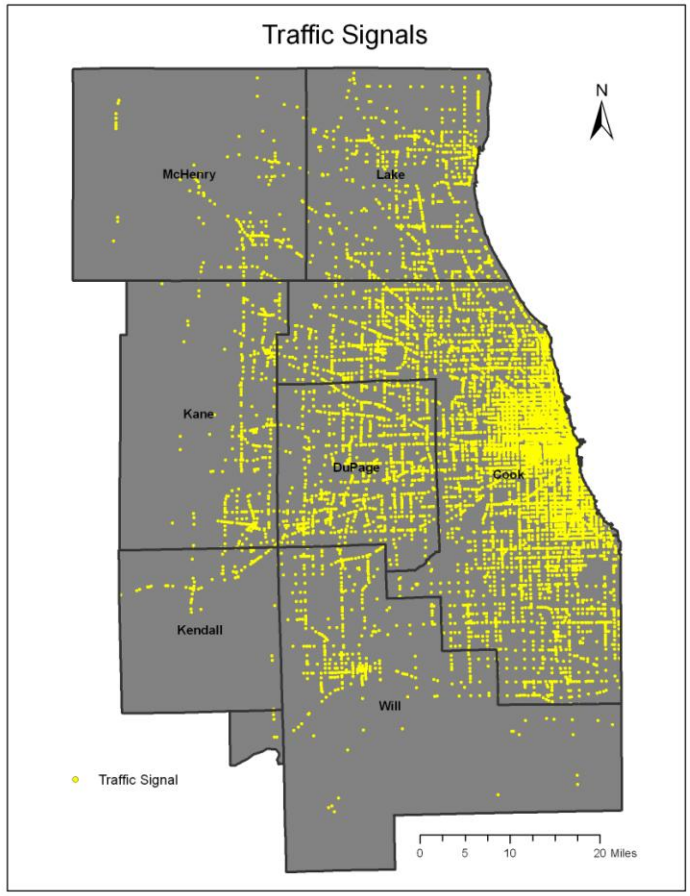
Two low-capital improvements to roadway operations were examined as part of this scenario. As with all strategies, these were applied systematically across the region; in this case, they were applied to all arterial roadways.

The first strategy involves access management, which is defined in CMAP's strategy paper on the subject (http://www.goto2040.org/WorkArea/DownloadAsset.aspx?id=13370) as "systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway." Access management usually reduces access points onto a roadway, which results in fewer turning conflicts and overall smoother vehicle operations, as well as improved conditions for bicyclists, pedestrians, and transit vehicles. This is not a new concept in the region, and many communities and roadway operators have conducted access management studies and pursued plans of this type.

In the transportation model, access management programs are represented by slightly decreasing delay on arterial roadways, but also adding a short distance onto automobile trips that begin or end in an area where access management was applied (to account for the use of a frontage road or combined access point rather than direct access from the roadway). The financial cost of access management programs, from a long-term perspective, is minimal; they are more accurately described as a policy change than a major investment.

The second strategy involves increased intersection efficiency, which basically involves the frequent optimization of signal timing. Transportation agencies that maintain signals periodically adjust signal timings to reflect constantly changing traffic conditions; standard practice is to optimize signals every 3 to 5 years. The "reference" scenario assumes that signal optimization occurs once every 5 years, and this is included among the activities necessary to maintain the basic operation of the transportation system. The "preserve" scenario increases the frequency of signal optimization, so that it occurs once every 3 years.

In the transportation model, this increased frequency of optimization is represented by a 5% decrease in delay at arterial intersections. This obviously has a greater impact on congestion in areas where signal density is higher; this is shown in the map to the right. There is not an additional capital cost required for more frequent optimization, but operational costs are higher, mostly reflecting more frequent signal timing studies. Initial cost estimates for signal timing studies vary from $5,000 (for a simple retiming) to $20,000 for a more detailed study; refinement of these cost estimates is still underway.



Results

The series of improvements made in the preserve scenario had substantial impacts on the operation of the regional transportation system. These results are described below.

Vehicle miles traveled and vehicle hours traveled (total and in congestion)

When compared to the reference scenario, the elements of the preserve scenario reduced vehicle miles traveled (VMT) and vehicle hours traveled (VHT), both in terms of total travel and travel in congested conditions. In all cases, the reductions were modest (between 3% and 6%).

However, these improvements were overwhelmed by the overall increase in tripmaking that is expected to occur by 2040 due to forecast population and employment growth. Although VMT in congestion and VHT in congestion showed improvements from the reference scenario, they still increased by around 46% and 35%, respectively, over current conditions. This indicates that other means are needed beyond the transportation management and operations improvements in this scenario to address our region's congestion.

To provide more detail on the effect of transportation system performance on freight movements, truck traffic is reported separately. The strategies in the preserve scenario are similar in effectiveness at improving truck performance as they are for passenger vehicles. Because truck traffic is expected to increase at an even higher rate than other traffic, truck VMT and VHT in congestion increased by around 60% over current conditions. Explicit attention to truck travel, which is not a feature of the preserve scenario, may be needed to address this.

Vehicle miles traveled (VMT) and vehicle hours traveled (VHT)

Measure	Current	2040 reference	2040 preserve	Difference, preserve minus reference	Difference, preserve minus current
Total VMT	173,543,681	199,842,335	194,495,716	-5,346,619 -3%	20,952,035 12%
VMT in congestion	31,894,121	47,760,613	46,521,980	-1,238,633 -3%	14,627,859 46%
Total VHT	7,211,823	8,758,414	8,278,433	-479,981 -5%	1,066,610 15%
VHT in congestion	2,583,120	3,710,978	3,495,987	-214,991 -6%	912,867 35%
Truck VMT	31,689,032	39,605,484	39,371,474	-234,010 -1%	7,682,442 24%
Truck VMT in congestion	5,575,160	9,670,255	9,297,601	-372,654 -4%	3,722,441 67%
Truck VHT	1,168,719	1,573,918	1,524,315	-49,603 -3%	355,596 30%
Truck VHT in congestion	384,333	645,544	609,448	-36,096 -6%	225,115 59%

Mode share

The "preserve" scenario resulted in considerable increases in transit ridership and the use of non-motorized modes (bicycling and pedestrian trips) when compared to the reference scenario, as well as a decrease in auto trips. When compared to current tripmaking, all modes increased, and transit and non-motorized trips both increased by over 60%. Transit mode share increased from 10% in the reference scenario (as well as currently) to just over 13% in the preserve scenario. Please note that these figures include all trips, not just work trips, and the total amount of trips made between the preserve and reference scenarios are approximately equal.

Trips by mode

Measure	Current	2040 reference	2040 preserve	Difference, preserve minus reference	Difference, preserve minus current
Auto trips	23,519,460	28,377,431	27,364,630	-1,012,801 -4%	3,845,170 16%
Transit trips	2,400,810	3,069,106	3,935,989	866,883 28%	1,535,179 64%
Non-motorized trips	355,706	492,444	578,045	85,602 17%	222,340 63%

Trip duration

The duration of trips fell between the reference and the preserve scenarios for transit trips, but stayed the same for auto trips (the small increase noted is within the level of "statistical noise" within the model). Transit trip time reduction was largely caused by decreased wait times. When compared to current conditions, the average duration of an auto trip increased slightly, while the average duration of a transit trip was reduced by a moderate amount. Please note that this figure includes all trips; work trips are generally longer in duration than others.

Trip duration (average minutes of travel)

Measure	Current	2040 reference	2040 preserve	Difference, preserve minus reference	Difference, preserve minus current
Auto trips	21.7	22.1	22.2	0.1 < 1%	0.7 2%
Transit trips	35.2	37.5	32.5	-5.0 -13%	-2.7 -8%

Additional analysis

Analysis of additional measures is available in the scenario pages of the *GO TO 2040* website, www.goto2040.org.