Results of "reinvest" 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 major systematic infrastructure investments was developed that is consistent with the general theme of the reinvest scenario. This scenario assumes that significant infrastructure investments in the transportation system are needed for it to continue to function. Each of the alternative regional planning scenarios subscribes to a different balance of capital and non-capital investment. This scenario includes the highest level of investment in 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: Infrastructure investments will not be pursued in the absence of other strategies. CMAP recognizes that the benefits of the strategy are magnified when linked with land use policies that encourage growth in areas served by these investments, for example. As a later step, the transportation infrastructure investments will be analyzed along with other strategies; but for this series of documents, CMAP is attempting to isolate and examine the benefits of individual strategies.
- 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 systematic transportation infrastructure investments 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 systematic transportation infrastructure investments associated with the reinvest scenario involve the following:

- The definition of systematic infrastructure improvement 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 systematic transportation capital strategies

The capital improvement strategies included in the reinvest scenario are made in a systematic way, across all facilities of a certain type rather than on specific facilities. For this reason, the systematic improvements described in this document are different than specific major capital projects, which are being addressed separately.

A significant limitation in this analysis relates to the use of the transportation model to evaluate these strategies. The model is not constrained by physical conditions, and is able to add capacity to a facility even such a capacity increase is not feasible. Therefore the results of this modeling exercise should be seen as a conceptual test of improvement types, rather than a recommendation for specific capital improvements. This point will be re-emphasized throughout this document.

Research on estimated costs of these improvements is also underway, and this document does not currently contain cost estimates for most of the systematic improvements described.

The strategies described in this document include:

- Capital improvements to transit facilities (1)
- Transit headway reduction (2)
- Freight operations improvements (3)
- HOV / truck-only lanes (4)
- Arterial improvements in redeveloping and congested areas (5)
- Pedestrian improvements in redeveloping areas (6)
- Significant application of transit-oriented development to allow and encourage growth in areas served by transit is a major part of this scenario; while this is not expressly a transportation strategy it is also evaluated in this paper (7)

1. Capital improvements to transit facilities

Systematic capital improvements to transit facilities can increase speed of transit service, improve schedule adherence, and overall generate additional ridership. As noted in the introduction to this document, there is a difference between specific major capital projects and systematic capital improvements; this description focuses on these systematic improvements.

From a modeling perspective, the effect of these improvements was to increase the travel speed of public transit vehicles by 10%. This was done across the board, with the travel speeds of all transit vehicles increased by the same amount. While this is obviously not how this strategy would actually play out (i.e. some services may not experience any speed increase, and others would increase by more than 10%), assuming a consistently applied speed increase is in line with the systematic approach of these strategies.

Speed increases were applied to transit vehicles of all types, although the actual improvements necessary to achieve the speed increase obviously vary. The types of improvements that are most relevant are consistent with the RTA's description of "enhancement" investments in the Moving Beyond Congestion report, online at http://movingbeyondcongestion.com/.

Bus improvements would include queue-jump lanes, intersection improvements to facilitate bus turns, designated bus-only lanes, station and stop improvements that allow fare pre-payment, and shoulder-riding enhancements, for example. Transit signal priority (TSP) would logically be a part of these improvements as well. For the purposes of consistency with the overall identities of the scenarios, TSP is included with other technology-focused features in the innovate scenario, but it is recognized that it is an important complement to other bus-based capital improvements. Rail improvements would primarily include track and structure upgrades as well as signal, electrical, and communication system improvements. Rolling stock upgrades would be relevant for both bus and rail transit.

Research shows that transit attracts more riders as speeds increase because transit travel times become more competitive with autos. Cross-city comparisons also indicate that improving transit speeds can also reduce congestion on nearby facilities or even systemwide.

A full analysis of the feasibility and cost of this strategy is obviously limited by the lack of consideration of existing physical constraints in the model results. However, evaluating the benefits of an across-the-board increase in transit speeds is still viewed as useful for long-range planning purposes.

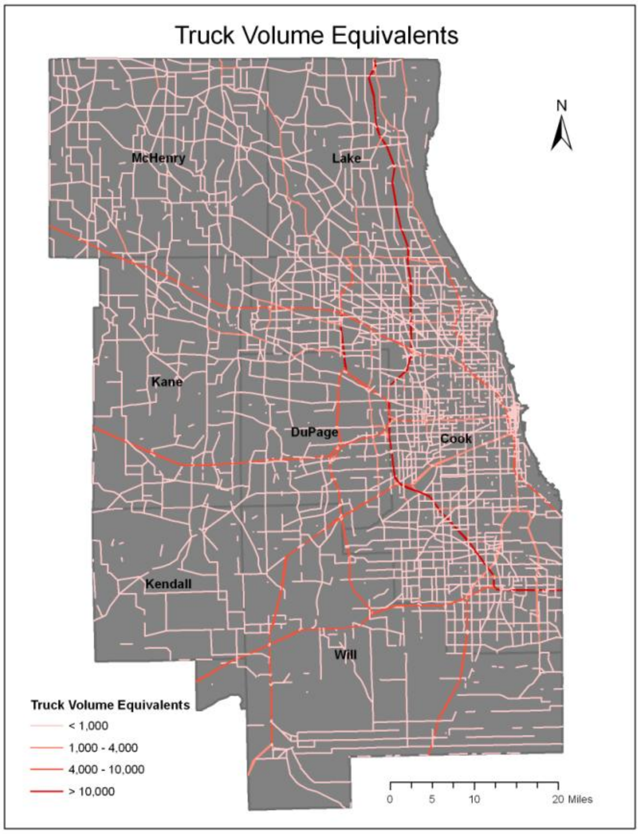
2. Transit system operations: wait time reductions

To be most effective, the capital improvements described previously would be linked with service enhancements so that the full value of the new capital additions could be realized. Please note that this strategy is identical to the wait time reduction strategy also described in the preserve scenario (http://www.goto2040.org/preserve_transportation.aspx), but in that scenario, it occurred without any supporting capital improvements. To avoid unnecessary duplication, this strategy is not described here in detail.

3. Freight operations improvements

This strategy involves making roadway modifications to facilitate the easier movement of trucks. The reinvest scenario is meant to freight and related industries (including other goods production and movement industries), and facilitating truck access is an important part of this.

A wide variety of actions, including infrastructure improvements, management and operation strategies, and policy changes, can improve truck movements. These are described in more detail in a strategy paper on freight which will be released within several months. Improvements related to infrastructure include making intersection design changes to



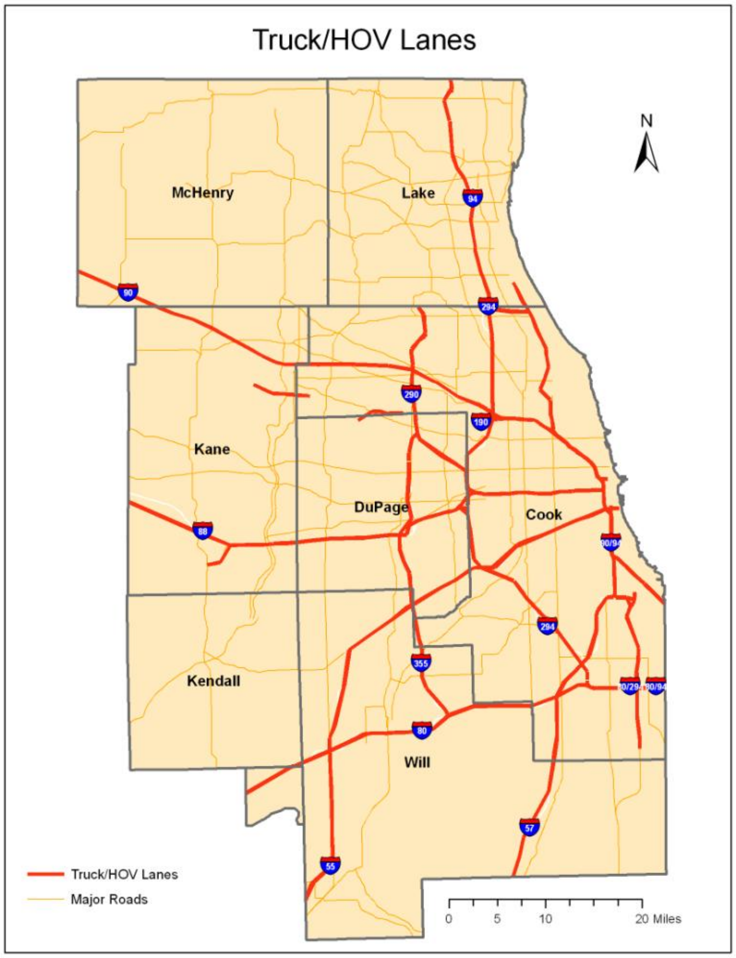
accommodate larger vehicles (as well as less costly measures such as removing parking, offsetting centerlines, and increasing sight distances), lengthening turning storage lanes, and addressing clearance issues. Non-infrastructure actions include designating additional truck routes, removing delivery restrictions, planning for loading zones and truck access within site design, and designating parking and staging areas. A combination of these various actions is assumed to make up the freight operations improvements in this scenario. Truck equivalent volumes in 2040 are shown in the map to the left.

The transportation model accommodates these actions by making trucks operate more like smaller vehicles. Within the model, trucks are "weighted" by their size to represent their equivalence to a certain number of passenger cars. This strategy reduces those weights. This not only speeds the movement of trucks, but it also reduces overall congestion for other vehicles on the same facilities. Based on the actions described above, this appears to be a reasonable effect; improving the ability of trucks to make turns, for example, can also improve traffic flow for other vehicles.

However, some intersection or roadway improvements that facilitate travel by trucks can have negative impacts on bicycle or pedestrian environment or other community features. Some of this can be mitigated through good facility design, but separation of high-freight roadways and pedestrian and bicycle facilities is also advisable. In this modeling exercise, the potential negative impact of increased truck volumes on non-motorized modes was not calculated.

4. HOV / truck-only lanes

This strategy tests the effectiveness of adding capacity but restricting its use to a certain class of vehicles; in this case, adding a lane for the exclusive use of trucks or HOVs was tested. This is treated as a type of managed lane, described in a CMAP strategy report online at: http://www.goto2040.org/managedlanes.aspx. Other types of managed lanes include dedicated express or reversible lanes, HOT lanes, or lanes where congestion pricing is applied (which is included as an explicit strategy in the innovate scenario). The focus on truck traffic in this strategy is consistent the scenario's general intent to support freight movement in the region.



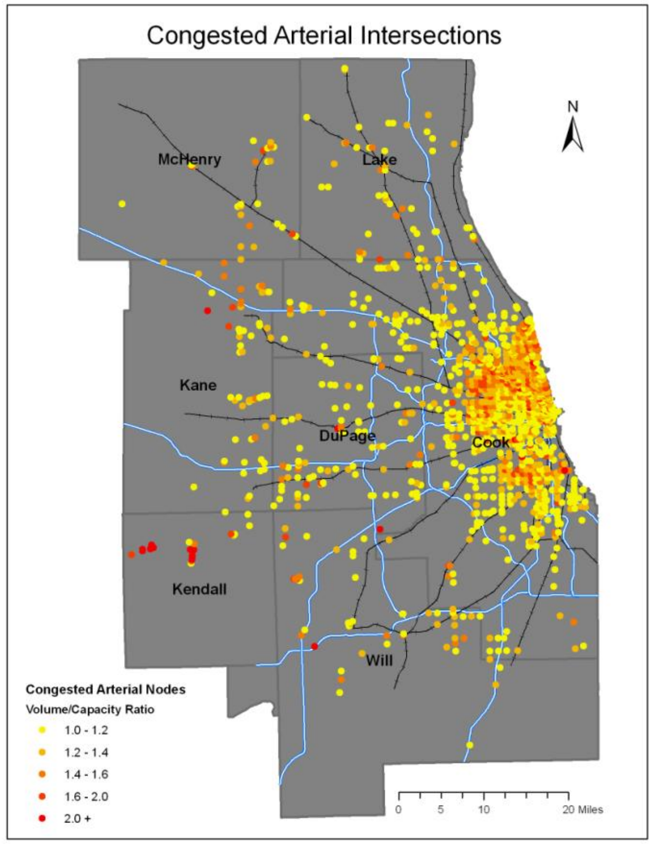
As noted earlier, this analysis is done to assess the systematic application of a type of capital facility and does not represent any specific, identified major capital projects. It is not expected that the additional lanes would be for the use of both trucks and HOVs in the same lane; one or the other of these vehicle classes would be specified. The physical feasibility of this strategy has also not been addressed.

This strategy was modeled by adding capacity to every expressway in the region, and this capacity was designated for the exclusive use of trucks or HOVs; this is essentially the equivalent of adding a lane for this purpose. This was also applied to interchanges and ramps in a systematic way. In the transportation model, trucks or HOVs were permitted to use other lanes if they chose, but no other vehicles could use the new designated lane.

5. Arterial improvements in redeveloping and congested areas

While the major focus of this scenario is on infrastructure improvements that support transit and freight, roadway improvements designed to address congestion in higher-density areas are also included. These improvements are in addition to the freight operations improvements already described.

Roadways where improvements to provide additional capacity were targeted were identified by selecting higher-density areas within the region (more than 3,000 households and jobs per square mile). Within these areas, arterial segments that had volume/capacity ratios over 1.0 (in other words, arterials that were experiencing congestion) were selected. This selection process was done to support redevelopment in dense areas of existing communities, with the assumption that infrastructure improvements may be necessary to continue to attract growth and development to these areas. The reinvest scenario includes the highest density development pattern of the three alternative scenarios, and it is assumed that improvements to existing infrastructure are needed to support this development pattern.



Capacity increases could be provided through a variety of means, not limited to roadway expansions. Some of the strategies described in the preserve scenario, including access management and frequent signal optimization, would accomplish this, as would ITS features that are further described in the innovate scenario. Practically, any improvements to arterials would also need to be balanced with consideration of non-motorized and transit trips, which are also important modes to support in dense, redeveloping areas. For this initial systematic assessment, potential conflicts between arterial capacity increases and the pedestrian environment (for example) were not evaluated, but this would clearly need to be done before any strategy such as this would be recommended.

The map to the right shows levels of congestion on arterial roadways with volume/capacity ratios over 1.0 and high surrounding densities. Please note that the extremely high levels of congestion shown in western and central Kendall County are the result of model errors which are being investigated.

As with all strategies, the physical feasibility of adding capacity to these roadways was not included in this initial modeling exercise, and costs still need to be estimated as well.

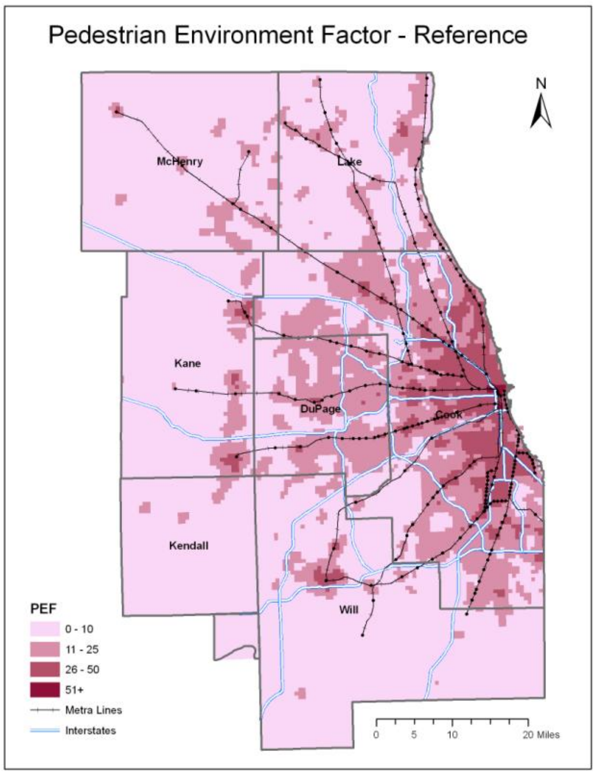
6. Pedestrian improvements in redeveloping areas

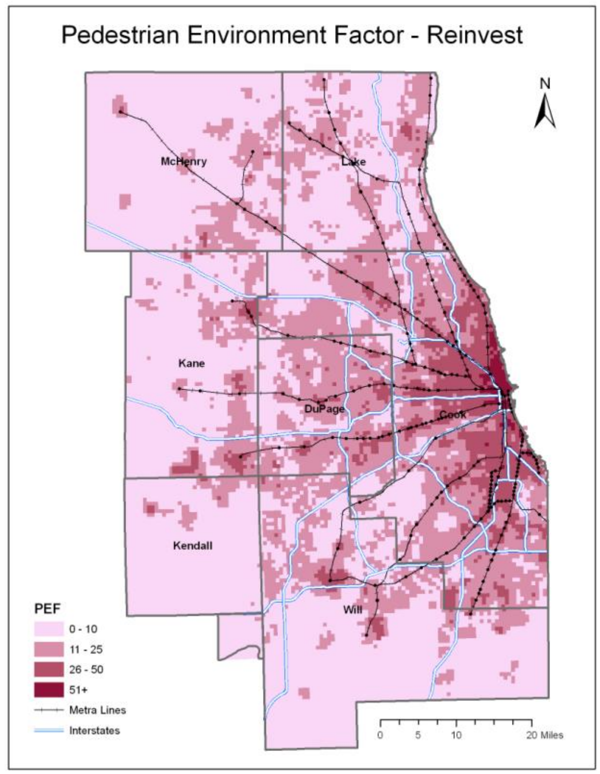
Improvements to the pedestrian and bicycle systems are reflected through increases in the Pedestrian Environment Factor (PEF). This is more fully explained in the preserve scenario description and will not be duplicated here.

The reinvest scenario also includes increases to PEF, but less intensely than the preserve scenario. The most significant PEF increases occurred in response to household or job growth. 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.

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.

Also please note that the PEF increases shown in the maps below are based on reference forecasts, which are simply extrapolations of NIPC's 2030 forecasts. A different forecast of households and jobs is being prepared for each alternative scenario based on the strategies included in each, and once this is used instead of the reference forecast, it will affect the changes to PEF.



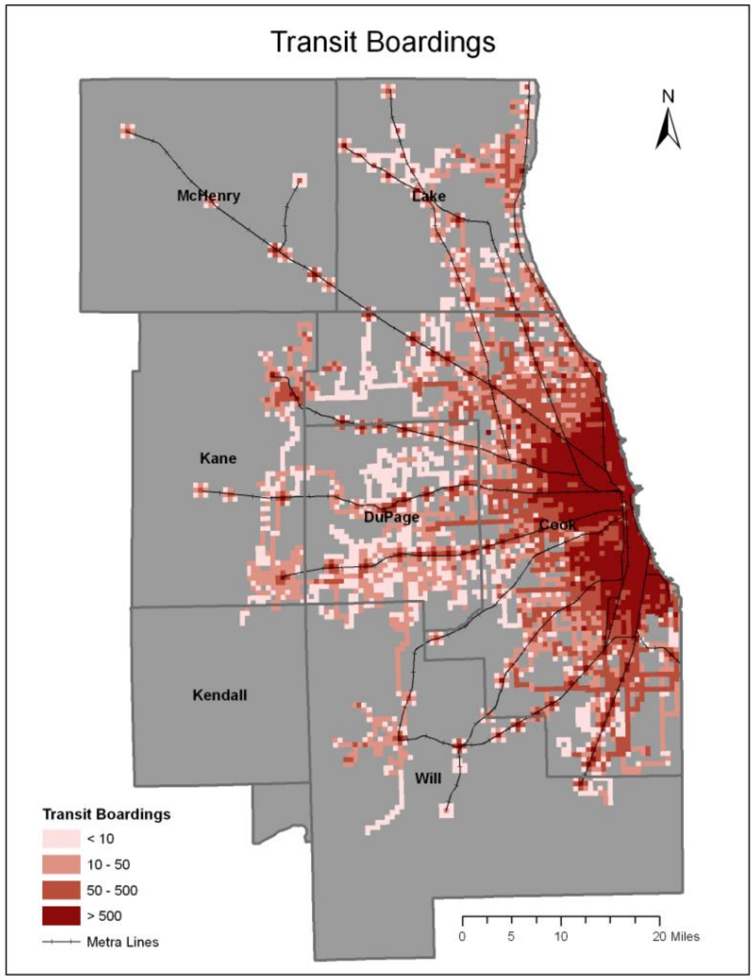


As with other strategies, there is clearly a need to estimate implementation costs for the new PEF improvements, but this is still underway. As with the preserve scenario, because most of the PEF increase accompanies new growth, some cost is likely to be borne by developers as part of this new development.

7. Transit oriented development

Transit oriented development (TOD) is a major part of this scenario, and even though it is may be more of a land use than a transportation strategy, it has significant transportation impacts. TOD is described in a strategy report that includes TOD as one common application of urban design, online at: http://www.goto2040.org/urbandesign.aspx.

The potential of different parts of the region to implement TOD was estimated by comparing assessed land value to the quality of transit service. Average equalized assessed land value was calculated for each area in the region, creating a land value index (LVI) that was used for this purpose. Assessed land values were collected from assessors offices across the region to support the development of the infill snapshot in 2007; this report is available online at: http://www.cmap.illinois.gov/snapshot.asp. These were then equalized based on the different assessment practices between counties. There is a high correlation between LVI and density, and it is assumed that changes in land use regulations that allow higher densities will have a corresponding increase on LVI.



Quality of transit service is challenging to measure, and several methods were considered to estimate it. Ultimately it was assumed that the level of ridership on a given transit service is a reasonable (though not perfect) proxy for its attractiveness. The map to the right shows the number of transit boardings for each subzone in the region. Metra boardings were "spread" to immediately adjacent subzones beyond the one in which the station was actually located.

This analysis assumes that the improvements in transit service in this scenario, plus the widespread adoption of TOD concepts regionally, will lead to considerably higher densities in places with current high levels of transit service but low land values, as measured by LVI. To reflect this, for each subzone, LVI was compared to number of boardings and equalized. In areas where the number of boardings would predict a higher LVI than actually existed, LVI was increased proportionally. This is assumed to reflect changes in land use regulations in these areas that permit higher density development, which would drive a LVI increase. This process led to significant increases in LVI on Chicago's west and south sides and also around many Metra stations throughout the region.

Within the transportation model, an increase in LVI will attract new growth to an area. Therefore this strategy will have the effect of increasing household and job growth in areas with good transit access but currently low density. After the "land use feedback" stage of the model is done, this will likely have an impact on transit ridership.

Results

The series of improvements made in the reinvest scenario had dramatic 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 reinvest scenario increased vehicle miles traveled (VMT) but reduced vehicle hours traveled (VHT) due to major congestion reductions. Congestion reductions were significant, both in terms of VMT in congestion and VHT in congestion, and reached 40% reductions for both of these measures. This was a reduction in congestion from current conditions, meaning that this scenario would actually have lower levels of congestion than today. However, it should be noted that this scenario is expected to have extremely high costs, and not all of the modeling assumptions that led to this outcome may be physically feasible.

To provide more detail on the effect of transportation system performance on freight movements, truck traffic is reported separately. Truck traffic particularly benefited in the reinvest scenario, which has a major focus on freight. Due to improvements in operating conditions, both VMT and VHT congestion for trucks was cut in half compared to the reference, and was also reduced from current levels by around 20%.

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

Measure	Current	2040 reference	2040 reinvest	Difference, reinvest minus reference	Difference, reinvest minus current
Total VMT	173,543,681	199,842,335	206,784,589	6,942,254 3%	33,240,908 19%
VMT in congestion	31,894,121	47,760,613	28,751,307	-19,009,306 -40%	-3,142,814 -10%
Total VHT	7,211,823	8,758,414	7,679,399	-1,079,015 -12%	467,576 6%
VHT in congestion	2,583,120	3,710,978	2,023,361	-1,687,617 -45%	-559,759 -22%
Truck VMT	31,689,032	39,605,484	37,224,411	-2,381,073 -6%	5,535,379 17%
Truck VMT in congestion	5,575,160	9,670,255	4,592,613	-5,077,642 -53%	-982,547 -18%
Truck VHT	1,168,719	1,573,918	1,249,299	-324,619 -21%	80,580 7%
Truck VHT in congestion	384,333	645,544	294,523	-351,021 -54%	-89,810 -23%

Mode share

The reinvest scenario resulted in increases in transit ridership when compared to the reference scenario, as well as a small increase in non-motorized trips and a small decrease in auto trips. When compared to current tripmaking, all modes increased, and transit and non-motorized trips both increased by over 40%. Transit mode share increased slightly, from 10% in the reference scenario (as well as currently) to just over 11% 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 reinvest and reference scenarios are approximately equal.

Trips by mode

Measure	Current	2040 reference	2040 reinvest	Difference, reinvest minus reference	Difference, reinvest minus current
Auto trips	23,519,460	28,377,431	27,649,397	-728,034 -3%	4,129,937 18%
Transit trips	2,400,810	3,069,106	3,399,531	330,425 11%	998,721 42%
Non-motorized trips	355,706	492,444	510,524	18,080 4%	154,819 44%

Trip duration

The duration of trips fell substantially between the reference and the preserve scenarios for both auto and transit trips, but by a much greater amount for transit trips. Decreases in both auto and transit travel times are likely due to the substantial investment in capital facilities that was made in both scenarios. The average duration of trips in the reinvest scenario was also lower than current trip lengths. 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 reinvest	Difference, reinvest minus reference	Difference, reinvest minus current
Auto trips	21.7	22.1	19.9	-2.3 -10%	-1.9 -9%
Transit trips	35.2	37.5	30.2	-7.3 -19%	-5.0 -14%

Additional analysis

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