

City of Gresham Active Transportation Planning Cost Benefit Analysis

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Background

To help communicate the benefit of City of Gresham's Active Transportation Planning efforts, Program Design and Evaluation Services (PDES) estimated the economic impact of proposed pedestrian and bicycle infrastructure improvements that support achievement of active transportation goals by the year 2040. The estimates are largely based on the economic benefits models produced by Alta Planning & Design for the Portland Area Active Transportation Initiative, which were based on earlier air quality benefits calculation used in bicycle and pedestrian master plans across the United States.¹ The analysis results, methods, and references are below.

Results

The estimated benefit to cost ratio is 2.48, indicating that for every \$1 spent to achieve City of Gresham's Active Transportation Plan targets, **\$2.48 of benefits** related to improved air quality, household transportation savings, and reduced healthcare costs will be generated over a 23-year period.

If increasing existing trends in active transportation mode share are considered, the benefit to cost ratio is 1.57; this indicates that for every \$1 spent to achieve active transportation goals, **\$1.57 of benefits** are accrued after accounting for increases in active transportation that may have occurred without infrastructure improvements.

The Approach

Given baseline (2017) and target (2040) mode shares for bicycling, public transit, and walking,² the adapted benefits model calculates the economic value of effects such as reduced carbon dioxide emissions, lower health care costs, reduced household transportation costs and prevented road damage that result from replacing vehicle trips with bicycle and walking trips.

Total and employed populations

Demographic information for the model was taken from the most reliable sources available. The baseline (2017) total population for City of Gresham was from the July 1, 2017 certified population estimates produced by Portland State University's Population Research Center (PSU PRC).³ Total population projections for the City of Gresham were derived by first taking the ratio of City of Gresham population to Multnomah County population and applying the ratio to the year 2040 population projections for Multnomah County produced by the PSU PRC.⁴ Then a population growth rate was calculated for City of Gresham to achieve the year 2040 population projection based on

the baseline (2017) population. The growth rate was applied to the baseline (2017) total population to obtain total population in each year across the 23-year period from 2017 to 2040. This approach was taken in the absence of population projections to the year 2040 for City of Gresham.

The baseline (2017) employed population for City of Gresham was obtained from the 2012-2016 U.S. Census Bureau's American Community Survey 5-Year Estimates.⁵ The employed population in subsequent years was obtained by applying the baseline (2017) ratio of City of Gresham employed population to total population (obtained from 2016 U.S. Census Bureau's American Community Survey 1-Year Estimates⁶) to the projected total population in each year.

Mode share

Mode share is the percentage of travelers using a particular type of transportation. The growth rate from baseline (2017) in bicycle, public transit, and walking mode shares was based on the year 2040 mode share targets as defined in the City of Gresham's Active Transportation Plan (p. 83).² Year 2040 mode share targets are 3% for bicycling, 20% for public transit, and 13% for walking. Then a growth rate for each active transportation mode share was calculated to achieve the year 2040 target based on baseline (2017) mode share: annual growth rates of 9% for bicycling, 3% for public transit, and 6% for walking are required to achieve year 2040 targets. The growth rate was applied to the baseline (2017) mode share to obtain the incremental increase in mode shares across the 23-year period to achieve the target mode shares in year 2040.

For each bicycle commuter, utilitarian bicycle trips were also calculated as an average ratio of shopping, dining, work-related and personal business bicycle trips made in relation to work trips by City of Gresham bicyclists. This ratio was derived from a GPS study of travel behavior by Portland bicyclists conducted by Portland State University researcher Jennifer Dill.⁷ Data from this study were also used to estimate bicycle trip distances by trip purpose, which were used to calculate reductions in vehicle miles traveled. Social and recreational bicycling trips are not included in the model because there is less reliable information on how often bicycle trips of those types replace vehicle trips.

City of Gresham auto commute mode share at baseline (2017) was used to calculate vehicle trip reductions from increasing active transportation commute mode shares and utilitarian bicycle trips. Auto mode share was derived from a combination of sources; public transportation, walking, and biking mode shares were taken from the City of Gresham Active Transportation Plan² and "taxicab, motorcycle, or other means" and "worked at home" commute mode shares were taken from the U.S. Census Bureau's 2017 American Community Survey 1-Year Estimates for Commuting Characteristics by Sex.⁸ Auto mode share was the remaining mode share proportion after taking these other mode shares into account. It was assumed that each new bicycle or walking trip had a chance of replacing the auto mode equal to the auto mode share at baseline (81.8% for City of Gresham). The auto mode share at baseline (2017) was used across all years despite increases to active mode shares, because accrued benefits from

vehicle trip reductions were discounted to prevent overestimation of benefits (the discount rate is described in more detail in the *Total benefits and discounted benefits* section below). The auto mode share for bike-transit commuters was assumed to be 39.0% based on data provided by TriMet (Portland area transportation agency), resulting in fewer vehicle trips reduced for increases to transit mode share. In addition, transit mode share was converted to bicycle-transit trips by assuming 3.27% of transit commuters accessed bus or light rail using their bicycle based on data provided by TriMet for the Metro benefits models.¹

Reductions in vehicle miles traveled (used for most benefits calculations) were derived by applying bicycle and walking trip distances to the number of vehicle trips reduced. Bicycle-transit trip distance and bicycle trip distance (both commute and utilitarian) were taken from the Portland Area Active Transportation Initiative benefits models, which were derived from data provided by TriMet (bicycle-transit trip distance)¹ and the aforementioned study by Dill and Giebe (commute and utilitarian trip distance).⁷ The average walking commute trip distance was obtained from the 2017 National Household Travel Survey (Table 27, p. 80).⁹

Total benefits and discounted benefits

Most economic benefits were calculated on a per-vehicle-mile basis using the net number of vehicle miles replaced by bicycle and walking trips each year. These benefits and reduced costs were derived from various federal sources, including the Environmental Protection Agency (vehicle emissions rates)¹⁰ and the National Highway Traffic Safety Administration (emissions costs, vehicle operating costs).¹¹ Health care savings and road maintenance savings figures were taken from peer-reviewed studies in transportation and public health journals.^{12,13} Per-vehicle-mile costs of traffic congestion and crashes were taken from a 2008 study by the American Automobile Association.¹⁴ Of note, carbon dioxide emission costs and vehicle operating costs assumed growth rates of 2.4% and 2.1%, respectively. In addition, reductions in vehicle miles traveled were converted to reduced vehicle emissions using baseline (2017) emissions values (pounds of emissions per mile), despite expected improvements in vehicle emissions and fleet composition changes that reflect consumer preferences for “cleaner” automobiles over time. This is because the resulting economic benefit from reduced emissions costs is discounted, so reducing emissions values over time to reflect cleaner automobile preferences plus discounting associated monetary benefits would undercount the cumulative value of emissions reductions over time.

Lastly, roadway maintenance costs and health care cost savings were adjusted to 2017 dollars using the Bureau of Labor Statistics Inflation Calculator.¹⁵

Based on the Portland Area Active Transportation Initiative benefits models, a discount rate of 3% was applied to carbon dioxide reduction benefits and discount rate of 7% was applied to all other benefits. Based on the discount rate, a discount weight was calculated as $1/(1+r)^t$, where r is the discount rate and t is how many years in the future the benefit will be realized. The discount weight was applied to benefits (\$) in each year and cumulative discounted benefits were calculated across the 23-year

period. Of note, benefits within a year were calculated as an increase from baseline (rather than an increase from the year prior) and then discounted using the aforementioned weight so as to not overestimate the benefits accrued over time.

Accounting for existing trends in active transportation mode share

To account for changes in active transportation mode shares already taking place (and thus identify the unique contribution of active transportation infrastructure improvements), the benefits model was repeated using transit, walking, and biking mode shares projected for the year 2040. Projected mode shares were calculated using the U.S. Census Bureau's 2005-2009 American Community Survey 5-Year Estimates¹⁶ to establish a baseline trend from 2009 through 2017; the resulting linear equation was used to estimate year 2040 commute mode shares for public transportation, biking, and walking. After the benefit model was repeated for projected mode shares based on existing trends, the difference in cumulative discounted benefits between the two models was used for a benefit to cost ratio that accounted for existing trends in active transportation use.

Costs

Estimated costs for active transportation infrastructure improvements were taken from the City of Gresham Active Transportation Plan (pp. 72 & 73).² Of note, costs were available for the top six prioritized pedestrian projects and top 10 prioritized bicycle projects. In addition, costs did not include maintenance costs over time, which is a limitation that may overestimate the benefit.

Benefit to cost ratio

The benefit to cost ratio was calculated as the cumulative discounted benefit in year 2040 divided by the total costs from the top 16 pedestrian and bicycle projects prioritized in the City of Gresham Active Transportation Plan. The benefit to cost ratio was calculated separately for cumulative discounted benefits with and without accounting for projected increases in active transportation mode shares based on historical trends (\$1.57 vs. \$2.48).

Future Adaptations

The benefits model could be updated to reflect targets for additional active transportation infrastructure improvements, such as those related to Safe Routes to Schools. The current model provides a conservative estimate of the benefits related to health improvements from increased physical activity due to active transportation infrastructure improvements. While the model applies health care cost savings from one study by Wang, et al. (\$585.97/person/year), the model could also monetize the health benefits from improved air quality through reduced automobile emissions or reductions in pedestrian and cyclist injuries and fatalities from reduced collisions due to the improved safety of active transportation routes. The model could also be updated to reflect the additional benefits of equity-focused infrastructure improvement projects, since health equity was one component by which City of Gresham projects were rated in the community-led prioritization process. Indeed, cost-benefit guidance from the

Victoria (British Columbia) Transport Policy Institute notes an additional economic benefit of \$0.35 per person-mile for improved walking and cycling conditions that significantly benefit marginalized communities.¹⁷ While the benefits model was applied to the general population of the City of Gresham, active transportation improvements may have more benefit for Communities of Color and lower-income communities who may have more of a need for alternative transportation options. A recent report from the League of American Bicyclists, “The New Majority: Pedaling Towards Equity” found that the fastest growth in bicycling is among Hispanic, African American and Asian American populations.¹⁸ This means that benefits derived from the total population may be an underestimate of the true benefit of infrastructure projects that were prioritized with health equity in mind.

Assumptions and Limitations

There are several assumptions and limitations to the benefit calculations that should be considered. First, the model assumed a linear growth in the City of Gresham total and employed populations from baseline to year 2040. The model also assumed a consistent ratio of City of Gresham to Multnomah County total population for the City of Gresham projected population. Similarly, a consistent ratio of total population to employed population is assumed for City of Gresham employed population projections. A linear growth is assumed for active transportation mode shares to reach year 2040 targets. In reality, public transit mode share is heavily dependent on funding levels, which makes transit ridership non-linear. Project costs only include capital costs and do not include maintenance costs, which may overestimate the benefit. In addition, costs only represent the top 16 prioritized pedestrian and bicycle projects rather than all projects considered in the Active Transportation Plan. Consequently, it is assumed that year 2040 targets would be achievable based on implementation of these prioritized projects.

References

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Note: Portions of the cost-benefit analysis used the U.S. Census Bureau’s 2012-2016 American Community Survey 5-year estimates. While references above reflect this, links associated with the references go to the new 2013-2017 American Community Survey 5-year estimates which were made available on December 6, 2018 after the analysis was completed.