Appendix 5

Detailed Bike Sharing BCA Methodology

A detailed methodology of the bike-sharing BCA is provided here because of the limited previous work in the area of valuing benefits from unique non-motorized transit system. Bike sharing is a relatively new concept throughout the world.

The cost-benefit model for the bike-sharing package is based on a relatively simple framework of three major sources of costs and seven major sources of benefits and a set of basic and complex assumptions.

Basic programmatic assumptions are as follows:

- 3564 total bikes in the system (2564 of which are included in the funding request), which will increase 2.5% a year under the assumption that the program will be expanded to eventually achieve ideal saturation (roughly 200 residents per bike).
- This bike-sharing system will be similar in size to the Montreal, Barcelona, and Lyon bike-sharing systems. The greatest data is available for the much larger Paris bike-sharing system. Therefore, a combination of experiences from these global models was used to generate system assumptions, such as revenue generation, mode shifts, and ridership.
- Each bike will be used by 6 people per day, but this increases 5% a year as the system expands.
- Each person will make 2 trips (1 roundtrip).
- The average bike trip length is 1.5 miles, according the COG Household Travel Survey (HHTS) 2007/2008. This is used as the average trip length for all trips assumed to have been replaced with a bike trip.

The major costs are: capital, O&M, and increased accidents. The assumptions behind these costs are as follows:

The **capital cost** is a combination of station, bicycle, and installation costs. This includes initial system set-up, such as bicycles, docks, map frames and card-readers. Each bike is also assumed to require replacement every 6 years for a cost of $1000 per bike.

The **operating cost** is $155 per bicycle per month, which includes an 8% theft and vandalism rate, as well as bicycle redistribution, bicycle maintenance, and maintenance of the regional website.

Both the capital and operating costs are based on the Bixi system in Montreal.

Accident costs are based on the current accident rate, bicycle ridership, and an accident increase factor per new cyclist added to the road. Injuries and fatalities were obtained from the Virginia Department of Motor Vehicles, Maryland Office of Highway Safety, and the District Department of Transportation. Bicycle ridership was obtained from the HHTS for both 1994 and 2007/2008. The accident increase factor per new cyclist was obtained by applying the following equation: (new ridership / old ridership)$^{0.4}$, which was taken from Jacobsen's "Safety in Numbers" (2003). The accidents attributable to the bike-sharing program were estimated by taking the difference in yearly accidents involving cyclists with bike-sharing and without. Accident cost assumptions were used as follows: $6 million per fatality and all injuries were assumed to be moderate in nature at $93,000 per injury.

The major benefits are: user cost savings, travel time savings, increased access, congestion reduction, emissions reduction, improved public health, and accident reduction. The assumptions behind these benefits are as follows:

User cost savings are a determination of the change in the direct per mile user fees paid by travelers based on mode shifts, which in this case are shifts to bike from auto, taxi, transit, and walk or personal bike. Assumptions behind this determination include average trip length (provided from the HHTS 2007/2008); vehicle operating cost, based on fuel costs, maintenance, repair, tire costs, and capital depreciation; average transit fares, based on average rail vs. bus trips, SmarTrip usage, and fares; average taxi fares; and bike fees, based on likely percentage of members vs. day pass users. A parking fee assumption is also applied to all auto trips, which represents the average daily parking cost in DC.

Travel time savings are a similar determination that measures the time difference for bike trip shifted from another source. Assumptions behind this calculation include mode shifts, average trip length, average speed by mode (including an average transit wait time of 5 minutes), and value of time, which was taken from the NHTSA guidance.

Increased access is a determination of the benefit from trips taken that previously were not possible or worth the time or cost. This benefit was calculated using a consumer surplus model, where it is based on the difference between the user/time cost of the next cheapest possible mode (assumed to be bus transit) and the new bike-sharing option.

Congestion reduction is based on an assumption of the congestion relief benefit for each VMT reduced. This is therefore based on VMT reduction calculations and a congestion reduction value, taken from NHTSA guidance. VMT reduction calculations are based on the average trip length, trips shifted from auto and taxi to bike, and also trips shifted from auto to transit, resulting from increased transit access from bike-sharing. New transit generation was determined using a percentage of bike-share trips connected to bus or rail transit and applying a percentage based on the number of people and jobs with new access to transit and ideal bike-sharing locations.

Emissions reductions is a straightforward determination of reductions in VOCs, NO_x, $PM_{2.5}$, and CO_2 based on average light duty fleet emissions rates from COG's Mobile 6 model used for air quality conformity and the VMT reductions described above.

Improved public health is determined using assumptions taken from a recent Rails to Trails report on active transportation, including the health care cost increase for people completing 30 minutes of daily exercise vs. those that currently do not ($20 per year), the percent of those bicycling or walking who do not meet activity recommendations (conservatively assumed to be 20%), and the average extra exercise time needed to meet the requirement (15 minutes).

Accident reduction is a simple calculation assuming that with each VMT reduced, accident risk decreases. Therefore, a value per VMT for accident reduction, taken from NHTSA guidance, was applied to the total reduced VMT.