Translating Demand and Benefits Research into Guidelines

Demand

Our approach to estimating the use of a new facility rests on two main assumptions. First, all existing bicyclists near a new facility will shift from some other facility to the new one. Second, the new facility will induce new bicyclists as a function of the number of existing bicyclists. Research for this project uncovered that people are more likely to ride a bicycle if they live within 2,400 meters (1.5 mile) of a facility than if they live outside that distance (Midwest Regional University Transportation Center Report). The likelihood of bicycling increases even more at 1,600 and 800 meters. We therefore estimate existing and induced demand using 800, 1,600, and 2,400 meter buffers around a facility.

We base our estimates of existing bicycling demand on U.S. Census journey to work mode shares. We establish the number of residents within 800, 1,600, and 2,400 meter buffers of the facility by multiplying the area of each buffer by a user-supplied population density. To identify the number of existing daily bicycle commuters who will shift to the new facility, we multiply the number of residents in each buffer (*R*) by 0.4, assuming that 80 percent of residents are adults and 50 percent of adults are commuters. We then multiply this number of commuters in each buffer by the region's bicycle commute share (*C*).

$$\text{Daily existing bicycle commuters} = R \cdot C \cdot 0.4$$

Adult commuters represent only a portion of adult bicyclists. We compared U.S. Census commute shares to National Household Transportation Survey (NHTS) data and found that the total adult bicycling rate ranges from the Census commute rate at the low end to 0.6 percent plus three times the commute rate at the high end (Appendix A of the NCHRP Report 552). This allows us to use readily-available Census commute shares to extrapolate total adult bicycling rates (*T*).

$$T_{high} = 0.6+3C$$
$$T_{moderate} = 0.4+1.2C$$
$$T_{low} = C$$

We multiply a low, moderate, and high estimate of this rate by the number of adults in each buffer to arrive at the total number of daily adult cyclists.

$$\text{Total daily existing adult cyclists} = R \cdot T_i \cdot 0.8$$

To obtain the number of existing daily child cyclists, we multiply the number of residents in each buffer by 0.2 to approximate the number of children, then by 0.05 to estimate the number of children who ride a bicycle on a given day (2001 NHTS shows that approximately 5% of children ride a bicycle on a given day).

$$\text{Daily child cyclists} = R \cdot 0.2 \cdot 0.05$$

Multiplying each of the existing cycling groups (commuters, total adults, and children) by the likelihood multipliers found in our research (*L)* for each buffer provides an estimated number of induced cyclists in each group.

New commuters = existing commuters · L
New adult cyclists = existing adult cyclists · L
New child cyclists = existing child cyclists · L
Where:
$L_{800m} = 0.51$
$L_{1600m} = 0.44$
$L_{2400m} = 0.15$

Mobility Benefit
Our research found that bicycle commuters are willing to spend 20.38 extra minutes per trip to travel on an off-street bicycle trail when the alternative is riding on a street with parked cars (Appendix D of the NCHRP Report 552). Commuters are willing to spend 18.02 minutes (*M*) for an on-street bicycle lane without parking and 15.83 minutes for a lane with parking. Assuming an hourly value of time (*V*) of $12, the per-trip benefit is $4.08, $3.60, and $3.17, respectively. We multiply the per-trip benefit for the appropriate facility by the number of daily existing *and* induced commuters, then double it to include trips both to and from work. This results in a daily mobility benefit. Multiplying the daily benefit by 47 weeks per year and 5 days per week results in an annual benefit.

$$\text{Annual mobility benefit} = M \cdot V/60 \cdot (\text{existing commuters} + \text{new commuters}) \cdot 47 \cdot 5 \cdot 2$$

It should be noted that this methodology assumes that no bicycle facility previously existed nearby, aside from streets with parking.

Health Benefit
An annual per-capita cost savings from physical activity of $128 is determined by taking the median value of ten studies (Appendix E of the NCHRP Report 552). We multiply $128 by the total number of new bicyclists to arrive at an annual health benefit.

Annual health benefit = total new cyclists · $128

Recreation Benefit
A wide variety of studies of outdoor recreational activities (non-bicycling) generated typical values of about $40 per day in 2004 dollars. If a typical day of recreation is about 4 hours, this would be about $10/hour. Note that this is an estimate of the *net* benefits, above and beyond the value of the time taken by the activity itself. This estimate is also in line with a recent study of urban trails in Indianapolis, which used the travel cost method to find typical implied values per trip of about $7 – $20.

The "typical" day involves about an hour of total bicycling activity, so we value a day at $10 (*D*). From both NHTS and Twin Cities TBI, the average adult cycling day includes about 40 minutes of cycling. We use this, plus some preparation and cleanup time. We multiply this by the number of new cyclists minus the number of new commuters.

$$\text{Annual recreation benefit} = (\text{New bicyclists} - \text{New commuters}) * D \cdot 365$$

Decreased Auto Use Benefit

The decreased auto use benefits apply only to commuter and other utilitarian travel, as we assume that recreational riding does not replace auto travel. These include reduced congestion, reduced air pollution, and user cost savings. (The latter is not an externality, but is grouped here because it is also calculated as a function of reduced auto travel.) We multiply the total benefit per mile by the number of new commuters, multiplied by the average round trip length from NHTS (L).

We then consider two offsetting adjustments that ultimately leave the total number unchanged. First, there are utilitarian riders in addition to commuters and some of these trips will replace auto trips. Second, not all new bike commuters and utilitarian riders would have made the trip by car; evidence from NHTS suggests that something less than half of bike commuters use driving as their secondary commuting mode. For simplicity, we assume that the total amount of new bike commuter mileage is a reasonable number to use to represent the total amount of new bike riding substituting for driving.

The benefit per mile of replacing auto travel with bicycle travel is a function of location and the time of day. There will be no congestion-reduction benefits in places or at times when there is no congestion. Pollution-reduction benefits will be higher in more densely populated areas and lower elsewhere. User cost savings will be higher during peak periods when stop-and-go traffic increases the cost of driving.

Based on reasoning documented in Barnes' Mn/DOT Report 2004-50, congestion savings will be 0-5 cents per mile, and pollution savings from 1-5 cents per mile, depending on conditions. We assume the high end of this range in central city areas, the middle range in suburban areas, and the low end in small town and rural areas. For simplicity, we assume that all commuting and utilitarian trips are during congested periods. User cost savings were determined to be 3 cents per mile during congested peak periods and 0 otherwise, thus these are scaled by location in the same way as congestion savings. We assume that bicycle commuters work 5 days a week 47 weeks a year.

Overall, the savings per mile (S) are 13 cents in urban areas, 8 cents in suburban areas, and 1 cent in small towns and rural areas.

$$\text{Annual decreased auto use benefit} = \text{new commuters} \cdot L \cdot S \cdot 47 \cdot 5$$