Transportation Mode Shares Report FAC/FCA-041

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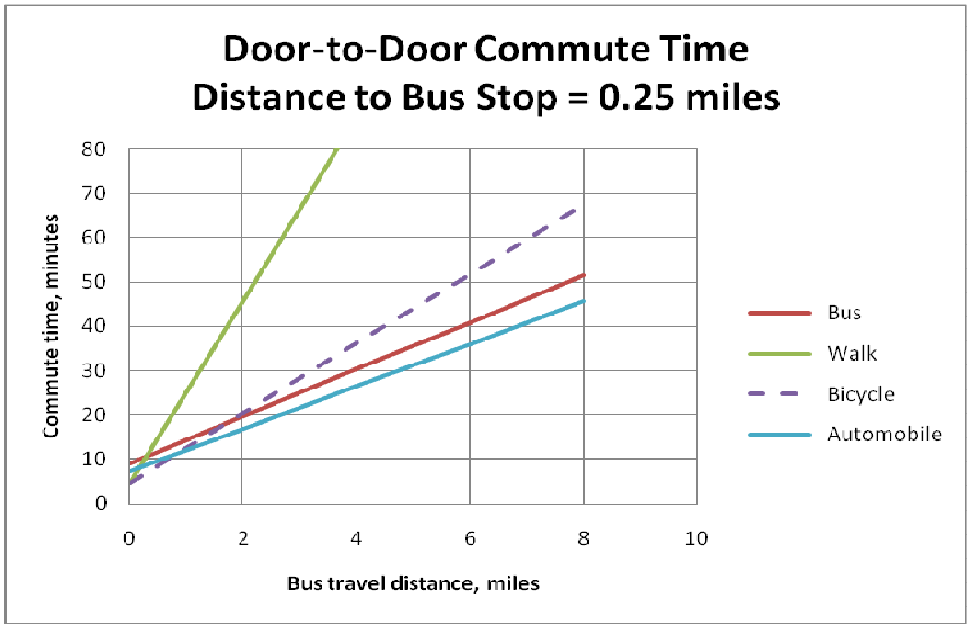
Introduction: Transportation is a key aspect of the future of Reston, due to the amount of development along the Dulles Toll Road and at the village centers. Mode split is a key aspect of future transportation. Mode split depends on the attractiveness of each mode to the commuter. Mode choice models typically combine cost and travel times to obtain a value that determines a person's mode choice[1]. The purpose of this report is to present the attractiveness based on door-to-door travel time and the cost associated with the travel.

Summary: For distances from home to work of less than 0.1 miles, walking is the fastest. Bicycling is fastest from 0.1 to 0.7 miles. Automobiles are fastest for distances greater than 0.7 miles. Buses are always slower than the other modes. The cost of the bus is less for distances greater than 8 miles, because the bus fare is independent of distance traveled. The travel times for the baseline case are shown in the following graph.



If the walk to the bus stop is less than 0.15 miles at each end of the trip, the bus time equals the automobile time. If the bus takes a more circuitous route than does the automobile, the bus takes 3 minutes longer per mile that the route is longer than the automobile route. For example, if the bus route is two miles longer, the bus takes 6 minutes longer.

For the baseline, we assumed that bus stops are spaced 0.5 miles apart. Wider spacing makes little difference in the bus time.

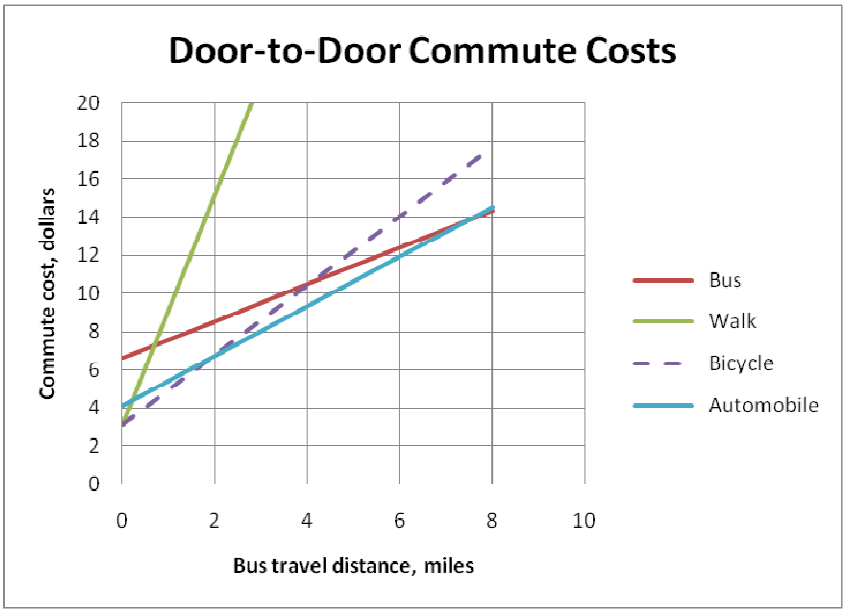
If the bus has priority at the traffic signals so that it is never delayed by the signal, the bus is the fastest mode except for near-zero bus travel distances; however, the true cost of the bus would be much higher if the bus runs on its own dedicated lane. Bus priority could be implemented without a dedicated lane so that this cost would not be incurred.

[1] Various examples can be seen by searching via Google for "mode choice model."

Discussion: We look first at the baseline case and then examine the sensitivities to various assumptions. For the baseline, we assume:

Bus travel	
Walking distance, home to bus, mi.	0.25
Walking distance, bus to work, mi.	0.25
Bus travel distance, mi.	2
Walking speed, mph	3.3
Between origin and destination	
Bus speed, mph (between stops)	25
Distance between bus stops, mi.	0.5
Stopped time per bus stop, sec	15
Distance between traffic signals, mi.	0.5
Percent green time	40%
Signal cycle time, sec	120
Bus fare (one way)	$ 2.00
Time valuation, $/hr	$ 20.00
Walk travel	
Walking distance, mi.	2.25
Bicycling travel	
Bicycling distance, mi.	2.25
Bicycle speed, mph	11
Parking time, sec	90
Walking distance from parking, mi.	0.1
Automobile travel	
Automobile distance, mi.	2.25
Travel speed, mph	25
Parking time, sec	180
Walking distance from parking, mi.	0.2
Operating cost, $/mile	$ 0.50

For this baseline case, but with varying the distance between the starting and ending bus stops (bus travel distance), the commute times are as shown in the graph in the Summary section. For distances under 0.1 miles, walking is the fastest. For distances between 0.1 and 0.7 miles, bicycles are fastest. The automobile is fastest for distances greater than 0.7 miles. The costs associated with each mode are shown in the following graph. Bicycles have the least cost up to 2 miles and automobiles, from 2 to 8 miles. Because the bus fare is independent of travel distance for Metro buses, the bus becomes most economical for distances greater than 8 miles. If the bus fare reflected the cost of bus service per mile, the bus might never be more economical than the automobile.



We next look at the sensitivities. For the sensitivity studies, we assumed bus travel distance is 2 miles. For the baseline, the walking distance to the bus stop is 0.25 miles. For other distances, we have as shown in the following table. If the commuter lives at the starting bus stop and works at the ending bus stop, so that the miles walk to the bus stop is zero, then the bus is the fastest mode; otherwise, the automobile is. The second set of values shows that the bus travel time increases approximately 3 minutes per mile. The bus travel time decreases only one minute if the bus stops are less frequent than 0.5 miles. If the bus has a priority at the traffic lights such that it has no delay at a traffic light, the bus is the fastest mode except for short bus-travel distances, in which case the 0.25-mile walk to and from the bus stops is longer than the 0.25-mile walk to work.

	For home-to-work distance = 2 miles																				
	Bus travel distance with 0.25-mile walk to bus					Miles walk to bus stop			Miles longer bus route				Miles between bus stops				Bus travel distance with bus red-light priority				
	0	2	4	6	8	0.00	0.25	0.50	0	1	2	3	0.5	1.0	1.5	2.0	0	2	4	6	8
Mode	Time, minutes																				
Bus	9	20	30	41	51	11	20	29	20	23	25	28	20	19	19	19	9	15	21	26	32
Walk	5	46	87	128	169	41	46	50	46				46								
Bicycle	5	20	36	52	68	19	20	22	20				20								
Automobile	7	17	26	36	46	16	17	17	17				17								

For the results of a recent survey, see http://www.census.gov/acs/www/?sid=ST2010121502000.

In the DC area, 66% get to work in a single-occupancy vehicle; another 11% go by automobile, but are with another person. Of the 22% taking public transit, 8% take metrorail (14% use buses, etc.).

Chris Walker had the following comments on this data:

1. These stories talk about commuter share. That is the metric most favorable to transit. A better measure is passenger miles or, even better, passenger miles times speed. The latter shows the passenger mile share for transit below 4% in our area, and declining.
2. The commuter emphasis does not take into account freight or commercial share of traffic. It's as if the products we all buy every day magically appear on store shelves. Transit serves none of this segment.
3. The story ignores the fact that transit trips take twice as long, on the average, as personal transportation trips. Is that extra time of no value?
4. The story does not talk about trip length. According to the National Transit database, public transit trips are half the length of personal transportation.
5. Transit works best with concentrated commute times, unlike the highway system. However, with more flexible work hours and telecommuting, the load is spread in a way that makes the time advantage of personalized transportation more important. Beware the promoters of new downtowns like Tysons Corner that, in order to work, will inevitably involve subsidies and growth restrictions elsewhere to give the landowners the "incentive" to build overpriced housing. It would be better to allow developers to put in place new, disbursed, unsubsized urban nodes that characterize the most successful new cities such as Los Angeles, Houston, and Atlanta.
6. All this would be simple to figure out if job and housing choices, and the time factor, were ignored, but these form the basis of how people live.