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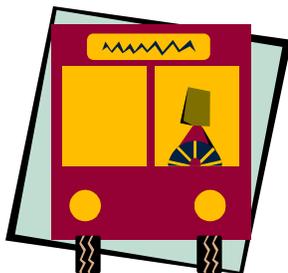
Busway vs. Rail Capacity: Separating Myth from Fact

BY PETER SAMUEL

One of the major misconceptions in U.S. transportation planning is the claim that rail has inherently higher capacity and provides better service than buses. Rail supporters aim to exclude bus modes from the list of alternatives as early as possible in any feasibility analysis. That is because buses almost always look good once they are properly analyzed for several primary reasons:

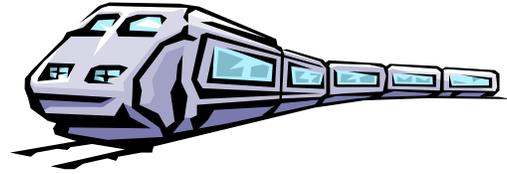
- The right of way—typically a lane of asphalt—is invariably cheaper than an assemblage of rails and power supplies and signals;
- Buses themselves are mass-produced by highly competitive manufacturers whereas rail cars are custom-designed by a handful of companies worldwide; and
- Like other motor vehicles, buses are adaptable and can take people from close to the actual beginning of their trip to close to the end of their trip. Moreover, as traffic and demographic patterns change, so too can bus routes. Rail, by contrast, is much more static and is substantially more limited in its ability to offer “door to door” service.

In an era of downsizing and economic decentralization away from core urban hubs, the small scale of the bus and its adaptability are a huge advantage over rail.



Veteran transportation analyst John F. Kain of Harvard summed it up: “With few exceptions studies of the cost-effectiveness of alternative modes have found that some form of express bus system, operating on either an exclusive right of way or a shared facility, would have lower costs and higher performance than either light or heavy rail systems in nearly all, if not all U.S. cities. The tendency of policymakers to ignore the abundant evidence on the superiority of high-performance bus systems is explained by a prior commitment to rail and a willingness to ‘cook the numbers’ until they yield the

desired result.”¹ Other scholars and researchers have come to the same conclusion: rubber-tired transit on roadway lanes is, in nearly all cases, more cost-effective, more flexible, and enables a higher level of service to riders than rail.²



False Comparisons

Rail promoters all too often distort comparisons between various rubber-tire transit alternatives and rail systems to conceal the advantages of rubber-tire transit. For instance, a study of transit options for the Washington, D.C. Beltway in Virginia did not include a busway alternative on the ludicrous grounds that no “continuous exclusive guideway” could be identified for a busway, even though a guideway could be identified for two distinct heavy rail lines and for a monorail³. Buses can use any right of way rail can use—a strip about 33 feet (10 meters) wide. In fact, buses can use guideways that rail cannot. Buses can negotiate steeper slopes and tighter turns than rail. So it is simpler to find right of way for bus, not more difficult.

This same study also cited the “inferior performance of BRT (bus rapid transit) against other modes,”⁴ without any indication as to what this might mean or reference to any research demonstrating this. In fact, most research shows that bus rapid transit offers superior performance for several reasons:

1. Buses can pick people up from points closer to their trip origin and drop them off closer to their final destination with fewer transfers. Unlike Rail, buses can be programmed to use local streets at either end of their run on a specialized right of way;
2. Buses can always bypass another disabled bus so breakdowns are less disruptive than rail where disabled vehicles must be pushed all the way to a siding before another rail car can pass;
3. Buses can easily be operated in express or non-stop mode whereas (except for rare cases like the four-track Lexington Avenue subway in New York) each train or trolley must stop at every station, so the proportion of unneeded stops is higher than for buses;
4. Bus vehicles come in many different sizes and configurations and can be tailored more closely to the special needs of the customers, whereas rail provides a one-size fits all formula;
5. There is a much shorter lead time on buying extra buses so it is easier to match capacity to demand; and
6. Buses and the lanes on which they operate have more alternate uses if things don’t work out.

Straw-man Comparisons

The same kind of distorted comparisons occurred in another study that examined new transportation options in the northern part of the Washington, DC. Where as, all current rail transit in the Washington, D.C, metro area is radial, leading in to the city center like spokes on the wheel, the Purple Line is planned to roughly follow the Beltway.

In the Purple line study, six rail alternates were designed, each connected directly to major centers like Bethesda and Silver Spring.⁵ But these rail alternates were compared, not with a busway in the same sensible alignment to attract ridership, but with a bus lane on the Beltway, several miles from the various activity centers they would serve. Beltway interchanges are hardly great places to pick up passengers, so the buses would have to go some miles on arterials to the Beltway, along the Beltway, then off the Beltway on another arterial several miles to the activity center. Not surprisingly this rigged set of alternates found the bus

alternate would attract a lot fewer riders than the rail alternates. A valid comparison of modes would put the two modes on the same route. Instead different routes were compared and the mode attached to the poorer route was then rejected as non-competitive.

Conclusion: if you compare mode-A on an impractical route with mode-B on a smart route, naturally mode-B will look better—even in cases where it is a lower-performing option.



Comparing Capacity

Another distortion that regularly appears is the claim that bus has limited capacity compared to rail. In Seattle rail enthusiasts at transit planning agency Sound Transit are proposing that an operating bus tunnel downtown be converted to light rail use with the claim this mode change will increase its capacity. In fact it will almost certainly reduce capacity, for the reasons discussed below, as well as cost a lot of money.

Rail advocates constantly cite false capacity numbers. Numbers quoted in the draft environmental impact statement (DEIS) for the Virginia Hampton Roads Third Crossing are typical. That study claims that a busway has a capacity of 4,000 to 12,000-passenger spaces/hour/lane or 1.5 to 4.6 equivalent conventional highway lanes (ECHL). By contrast light rail capacity is cited at 6,000 to 20,000/passengers/hour or 2.3 to 7.7 equivalent highway lanes and rapid (heavy) rail 10,000 to 72,000 or 3.8 to 27.7 equivalent highway lanes.⁶

The DEIS figure for busway capacity is so low because it quotes the maximum throughput of buses as 60 to 90 per hour. That corresponds to a headway of 40 to 60 seconds between buses (see table). According to Professor Vukan Vuchic, a veteran academic from the University of Pennsylvania that is widely cited in transit feasibility studies, this DEIS citation is a misleadingly selective use of quite complex findings. He says that the 60 to 90 buses/hour (headways averaging 40 to 60 seconds) refers to a situation in which there are no special bus terminals, and little capability of buses to pass at stops. So the constrained design of the stops, not the busway itself, is the limiting factor. Vuchic says it is possible to run buses safely at 6 to 8 second headways or 450 to 600 buses per hour per lane. If the buses carry 60 seats, that's a seated capacity of 27,000 to 36,000/hour.

Thomas Rubin, a California based consultant and former senior transit agency official in Los Angeles, says spacing of buses at 264 feet on 3-second headways at 60 mph is safe. That would yield 1200 buses/hour and passenger flows of up to 70,000/lane/hour. This is the huge capacity that could be achieved with busways. However, Rubin notes there are not many places where this huge capacity is needed. He also challenges the notion of heavy rail systems being capable of running at one-minute headways. The shortest headways in U.S. rail systems are achieved by the San Francisco Bay Area's BART, at 2 minutes and 40 seconds. Boston, Philadelphia and San Francisco run trolleys at 60-second headways, but only at low speed.

The Transportation Research Board's highway capacity manual recognizes a bus in a traffic stream as the equivalent of two cars so the capacity of an expressway lane commonly rated at 2,300 car equivalents/lane/hour will be able to handle 1,150 buses/lane/hour and at 40 to 120 passenger spaces per bus this puts busway capacity at 46,000 to 138,000 passengers/lane/hour—about six times the capacity of light rail and about twice that of heavy rail. Vuchic thinks this puts an inadequate stopping distance between vehicles and that properly trained drivers will operate at 6 to 8-second headways. But that is a 7.5-fold

increase in capacity over what is claimed for a busway by the DEIS consultants. And it is in the same range of capacity as heavy rail and well above light rail.

The reason buses can operate at so much shorter headways than trains is that trains generally file one by one into and out of stations, whereas several buses can pick up and drop off simultaneously at many points, before converging on a busway. Or when they come to a bus station, that station can be organized with multiple bays, allowing buses to load and unload simultaneously. Buses can also continue past the stop, or go onto different local streets and not delay following buses. A bus station or local bus stops are scalable to support a more intense per lane loading. Rail combinations or trains almost invariably have to wait for the train in front to load and unload because only one train can be at a station on the one line at any given time. Unlike buses they can't switch at each station into separate lanes.

That approximate 10-fold headway advantage of buses (6 seconds vs. 60 seconds) more than makes up for the fact that train cars are slightly wider and can be hooked together into trains.

Lincoln Tunnel Exclusive Bus Lane

No current U.S. busway quite matches that theoretical capacity of 1,150 buses/lane/hour (3-second headways) but the Lincoln Tunnel Exclusive Bus Lane (XBL) operated by the Port Authority of New York and New Jersey (Port Authority) comes reasonably close. It operates at an average 730 buses/hour in its busiest hour (5-second headway) and 450 buses/hour (8-second headway) over the full 3.75 hours of its daily operation. The average bus on the XBL carries 35 passengers so the Lincoln tunnel XBL is carrying close to 16,000 passengers/lane/hour throughout the morning rush hours and over 25,000 passengers/lane/hour in the busiest hour. And those are average weekday numbers, not maximum numbers.

Thus, the Port Authority has an operating busway system that on an average day does more than twice the throughput that many of the DEIS studies misleadingly quote as a maximum for buses!



And the Port Authority says the XBL busway could increase its carrying capacity. It presently has a bad merge point of buses coming from the north (IC-17) and from the south (IC-16E) on the New Jersey Turnpike, a merge they call the “teardrop,” which acts as a bottleneck that limits the flow of buses and often creates backups. The Port Authority is studying various improvements to the teardrop—such as ramp meter signals and extended merge lanes—that would allow the XBL to take more buses. It could probably handle 30,000 to 35,000 passengers/hour/lane. That's far more than most heavy rail lines actually carry, let alone light rail.

Conclusion

People are genuinely concerned that transit resources be spent effectively. As such, it is important that data that falsely belittles the potential of busways be identified and critiqued. Too often rail enthusiasts in state and local governments have used false citations and misleading data to prevent a fair comparison of bus with rail during the major investment study process. Feasibility studies have been distorted and the bus option precluded through disinformation. The U.S. Department of Transportation in the past year or so has launched

a Bus Rapid Transit program that purports to support higher-level bus projects. It would be helpful to its own program mission if it supported research to document bus capacity in various busway and bus lane configurations and bring into question the many false assertions that have driven much of the transportation debate.

About the Author

Peter Samuel is an Adjunct Scholar of Reason Public Policy Institute and is the Editor of TOLL ROADS NEWSLETTER. This policy brief was adapted from TOLL ROADS NEWSLETTER Number 56, October 2001, p. 22. Author Peter Samuel can be contacted at 301-631-1148, tollroads@aol.com.

Table: Busway vs. Rail Capacity Comparison			
Busway capacity estimate (source)	Headway used	Buses/lane/hour	Seats/lane/hour
Rail consultants	40-60 seconds	60 to 90	4K to 12K
Vukan Vuchic	6-8 seconds	450 to 600	27K to 36K
Thomas Rubin	3 seconds	1200	70K
TRB Highway Capacity Manual	N/A	1150	46K to 138K
Lincoln Tunnel XBL current	5 seconds	730	25K
Lincoln Tunnel XBL improved	4 seconds	910	30K to 35K
Rail consultants' light rail estimate	N/A	N/A	6K to 12K
Rail consultants' heavy rail estimate	N/A	N/A	10K to 72K

Endnotes

- ¹ John Kain, "The Urban Transportation Problem: a Reexamination and Update," in *Essays in Honor of John Meyer*, ed. Jose Gomez-Ibanez (Washington, D.C.: Brookings Institution Press, 1999) p. 384.
- ² See, for example, Thomas A. Rubin and James E. Moore II, *Rubber Tire Transit: A Viable Alternative to Rail*, Policy Study 230 (Los Angeles: Reason Public Policy Institute, August 1997).
- ³ State of Virginia, Department of Rail and Public Transportation, *Capital Beltway Corridor: Rail Feasibility Study* (Richmond VA: May 17, 2001) p. S-1.
- ⁴ Ibid, p. S-2.
- ⁵ RKK Engineers, State of Maryland, Department of Transportation, *Capitol Beltway Corridor Transportation Study* (Baltimore: Maryland Department of Transportation) (available at www.rkkengineers.com/sha/capital).
- ⁶ They offer a citation to Vukan Vuchic, a University of Pennsylvania professor in a chapter of a book published in 1992: George Gray, Lester Hoel (eds), *Public Transportation*, New Jersey: Prentice Hall.