# EVALUATION OF A NATIONAL EXPERIMENT IN BUS RAPID TRANSIT

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An extensive evaluation is being performed of a bus rapid transit system in Los Angeles that uses exclusive bus lanes in the median strip of a freeway. This national experiment is currently quite successful. Operational feasibility has been demonstrated, and the number of busway system riders has continuously grown over the first 18 months of operation even though the facility is only partially operational. The new riders are former automobile users, and their socioeconomic profiles are more similar to automobile commuters than to bus commuters. Assuming that car occupancy is only 1.3 persons/vehicle, the busway system has at least a tenfold greater capacity (per traffic lane) than the highway system. However, the busway lanes during peak periods currently carry only about half of the person trips that are carried by a freeway lane but are catching up fast. The principal causes for travelers switching from automobile to busway commuting, based on survey results, are to save travel time and to avoid the frustration of the stop-and-go characteristics of a congested freeway.

•THE San Bernardino Freeway Express Busway is an 11-mile (17.7-km) double-lane exclusive roadway for buses running east and west from downtown Los Angeles through a middle-income, suburban residential commute corridor. The busway lanes are physically separated by concrete and flexible barriers from those serving the automobile traffic, and this makes it a bus rapid transit system. This $60 million bus rapid transit system is the first such facility in the United States that is complete with on-line stations and double (bidirectional) bus lanes.

The eastern half of the busway was opened on January 29, 1973. On July 16, the first of its three rapid transit stations was opened at El Monte. This station, at the eastern terminus, is a modern facility complete with parking spaces to provide for automobile park-and-ride service. There are 700 completed spaces now, 700 to be built. The other two stations, one at a hospital and the other at a university, are destination stations and do not have parking facilities.

The San Bernardino Freeway Express Busway experiment and its forerunner, the Shirley Highway Busway in the Washington, D.C., metropolitan area, are of great significance to the national effort to rebuild public transportation. The busway form of rapid transit is a distinct alternative to rail rapid transit and has some apparent advantages. It is less costly to build than a suburban-to-downtown line-haul facility. It can be built quickly in 2 to 5 years; a rail facility would take longer. It is more flexible because the vehicle can leave the fixed right-of-way for collection and distribution. Routes and schedules can be changed easily. Currently, federal financial support is more readily available since federal and (usually) state highway trust fund monies can be used for construction of a busway facility.

The major uncertainty is the handling of the many buses converging on the downtown area. The concept and cost of a grade separation downtown bus distribution system have not been determined and could pose difficulties not present in rail rapid transit. The bus does not have the inherent comfort features of a train: room to move around, large seating area, and smoothness of ride. Finally, many people view the bus as an undesirable alternative to automobile or train riding because of its unreliable schedule, frequent stops and starts, and crowded and uncomfortable conditions.

The major objective of these busway experiments is to determine if the bus when put

into a rapid transit form can be found attractive by the riding public. If so, this more flexible and easier to implement form of rapid transit will play a large role in the national effort to rebalance public and private transportation services.

## EVALUATION METHODOLOGY

A comprehensive evaluation of the busway is being carried out as a joint effort of the Southern California Association of Governments (SCAG), the Urban Mass Transportation Administration, the Federal Highway Administration, the California Department of Transportation (DOT), the Southern California Rapid Transit District (SCRTD), and the city of Los Angeles. This 5-year effort assesses the operational and economic feasibility and the traveler response to the new facility.

Findings can be related to the other major national busway experiment, the Shirley Highway Busway. Findings are also related to the SCAG short-range transportation plan, by which the Los Angeles basin is to meet federal requirements for transportation planning and environmental protection. Thus, the busway project acts as a pilot demonstration for the busway elements of the short-range plan.

The evaluation is carried out through a variety of ongoing work tasks, which are described and interrelated in the following.

### Time Series Analysis

There is a continuous process of monitoring ridership on the busway and traffic counts on the parallel highway. Traffic counts include speed measurements, vehicle counts, and occupancy counts. Approximately every 6 months there are bus ridership and traffic counts throughout the entire corridor served by the busway. These data are plotted in a time series and include identification of events (i.e., process interventions) that might have an effect on ridership and traffic trends.

### Household Surveys

Approximately once a year a major household survey is conducted to interview commuters at their doorsteps. These interviews determine which commuters are using which modes and submodes, their socioeconomic profiles, the time and cost of the mode being used, and their reasons for using the present mode (why they have switched, if they have, and their attitudes toward and perceptions of the busway). A small, clustered random sampling process is used with a 6-min interview. This method reduces data collection costs to a few dollars per completed interview but enables a comprehensive cross-sectional analysis of the corridor to be obtained.

### On-Board Surveys

About once every 2 years, a comprehensive on-board survey is performed of busway users. These surveys supplement the household survey results with data, based on a large sample, on socioeconomics and attitude-perceptions and origin-destinations of busway users.

### Cost Analysis

A comprehensive cost analysis is performed of capital and operating costs of the busway. This includes an assessment of the impact of the faster busway operations on vehicle and personnel use.

### Market Analysis

From the survey results, the central market analysis is performed. A cost analysis is made of the mode not used so that the cost difference (disutility value) can be attached to each commute trip in the sample. The final analysis output is a measure of transit market share throughout the corridor served and of how patronage and market share are affected by various factors.

### Modal Split Analysis

Finally, the survey results are put into the traditional modal split framework so that a modal split curve can be obtained and compared with the curve used for rapid transit planning throughout the Los Angeles basin.

## RESEARCH FINDINGS

During the first 18 months of busway operation, when the data discussed were collected, only the eastern two-thirds of the busway and the El Monte station were operational, and most of the time there was no special handling of busways in downtown Los Angeles. Exclusive downtown lanes were incorporated and the western third of the busway was completed in the spring of 1974. The two on-line stations will be opened in September 1974. Figures 1 and 2 show some of the features of the busway.

### Public Acceptance

After 18 months of operation, there appears to be a warm acceptance of the busway concept by users and nonusers alike. The 1973 spring survey showed that residents of 82 percent of commuter households and 76 percent of noncommuter households were aware of the busway. By the fall survey, these numbers had changed to 86 percent and 73 percent and were highest, 92 percent and 78 percent, in the corridor area east of El Monte where busway service was already available.

Of all commuters interviewed during the fall household survey, 75 percent offered general praise of the busway (e.g., it will reduce pollution and improve total freeway efficiency). About 20 percent were negative (e.g., busway lanes are wrong, unsafe, too costly).

### Operational Feasibility

The operational feasibility of the busway system has been conclusively demonstrated. Buses have operated over the busway successfully and reliably. Automobiles have not invaded the exclusive bus lanes. To date, there have been no accidents attributable to the existence of the busway.

SCRTD has mastered the problems of rerouting and rescheduling to incorporate the new busway into their total system. The innovative El Monte station and park-and-ride facility has functioned without major customer problems since its opening.

### Ridership Growth

Commuters have responded favorably to the busway, and the ridership on the busway transit lines has risen dramatically (Table 1). A time series graph of this ridership compared with ridership growth of the Shirley Highway Busway is shown in Figure 3.

This growth has also been measured in terms of market share. The transit market is defined as the total of all commuters who live within the San Bernardino Freeway

**Figure 1. San Bernardino Freeway Busway.**

**Table 1. Ridership growth on San Bernardino Freeway Express Busway.**

| Time | Riders | |
|---|---|---|
| | Peak[a] | Off-Peak[b] |
| January 1973 | 1,200 | 800 |
| April 1973 | 1,250 | 750 |
| September 1973 | 2,500 | 1,200 |
| December 1973 | 4,000 | 1,600 |
| June 1974 | 7,500 | 3,000 |

[a]5.5-hour period of morning inbound and evening outbound traffic.
[b]Between 6 a.m. and 8 p.m., both directions.

**Figure 2. Busway park-and-ride terminal.**


corridor in areas that are or will be served by the busway and who regularly commute to the Los Angeles area. The transit share of this market during 1973 has risen from 12 to 16.5 percent. More important, the transit market share of the eastern portion of the corridor that was served by the busway in 1973 has risen from about 4 to 25 percent.

## Comparison of Highway and Busway

Because busway patronage is still growing, one cannot yet compare highway and busway volumes. The number of bus runs operating over the busway was quadrupled with the opening of the El Monte station. Although patronage has risen dramatically, it has not yet caught up with this greatly increased supply of service. Similarly, the inbound busway lane is currently carrying only about two-thirds as many people as adjacent automobile lanes.

As the many additions to the busway are incorporated in the coming phases, busway ridership will hopefully surpass that of the parallel highways. Although measurements of capacity have not yet been taken, this report suggests that the busway capacity will be at least 14,000 riders/hour. Assuming the current 1.3 persons/automobile, this is more than five times larger than the capacity of a highway lane.

Of course, there is no rationality in suggesting that the busway lane should carry the same number of rush-period trips as one of the parallel highway lanes. The busway lane costs more to build and to operate but produces many more benefits in terms of reduced air pollution, conservation of energy, and fewer traffic accidents. At some volume, the busway will be equal to the competing highway lane in terms of benefits and costs.

## Causes of Busway Ridership Growth

During the 1973 period when most of this analysis was performed, the busway was in only a partially completed state. At that time, the busway service was only about 5 to 7 min faster than automobile commuting. This small time savings was only obtainable through the park-and-ride and kiss-and-ride modes (the upsurge in use of these two modes represented most of the busway patronage growth). There were essentially no monetary savings in using the busway until the low ($0.25) fare was incorporated in early 1974.

Following are the primary reasons given by those who have switched over to the busway mode and the percentage ranking for the various reasons:

| Reason for Switching | Percent |
|---|---|
| Time, convenience | 46 |
| Frustration with automobile | 18 |
| Cost savings | 14 |
| Employment change | 9 |
| No reason given | 9 |
| Other | 4 |

The parallel freeway lanes are operating at capacity with traffic slowed to 30 to 35 mph (48 to 56 km/h) most of the time. It is important that busway ridership growth is linked to congestion on the freeway. If the congestion were reduced by increasing highway capacity, the primary stated reason for switching modes would be removed. Thus, the growth in busway ridership would probably be halted and possibly reversed.

## New Transit Users

Traditionally, there has been a significant difference in the socioeconomic characteristics of automobile and transit commuters. Transit commuters have tended to be more often female, have less income, and be more limited by automobile availability. The data in Table 2 give a profile of the new people being drawn to the busway system and indicate that they tend to more closely resemble the automobile commuter than the traditional bus user.

The data for busway users (Table 2) are based on a small sample of interviewees, but the differences between these data and the data on prebusway transit users are, in general, statistically significant.

## Modal Split Implications

One purpose of the busway evaluation is to provide a check, based on marketplace conditions, of the modal split curves now being used in rapid transit planning in the Los Angeles area. This check now appears to be somewhat inconclusive; the modal split values obtained from interviews of >600 commuter households are about five percentage points higher than those values currently being used for planning (Figure 4).

The disutility function (against which the modal split value is plotted) represents the differential in total cost in dollars between commuting by transit and by automobile. The cost for each mode includes the travel time, valued at one-fourth of the traveler's wage rate; excess time (waiting for or walking to or from vehicles), valued at a rate 2.5 times higher than riding time; and all economic costs. The survey procedure includes a detailed accounting of parking costs, car-pool payments, and receipts. The difference in this total cost between the two modes is the disutility value. Where this value shows transit to be better (i.e., less costly), the transit modal split should be high (Figure 5).

The San Bernardino Freeway corridor seems to have a relatively higher transit modal split than other sectors of the Los Angeles basin. There are distinct reasons why the transit modal split values might be higher in this corridor. Bus service in this corridor has always been maintained at a high level and has always been well patronized. The prebusway, 1972 on-board survey revealed that about one-third of all bus commuters in this corridor were using the bus by choice rather than by necessity. Approximately 40 percent of these commuters had selected their residential location in proximity to bus service. This long-term institutional relationship between commuter and bus service tends to keep the transit market share value high. Thus, the busway service was introduced to an area where transit had enjoyed a good image for years.

## Attitudes

The evaluation has proved conclusively that there is an attitudinal factor that affects the modal choice decision process, and this factor is as important, in terms of effect, as travel time and travel cost savings. Figure 5 shows the modal split curve (Figure 4) for subsets of the survey population who revealed positive and negative attitudes toward transit. These subsets are based on the degree of agreement or disagreement with the following attitudinal statements:

1. If new, improved, and convenient public transportation service were introduced, I would certainly use it; and
2. I hate to be tied to fixed schedules for traveling.

These curves show that those people who indicated positive attitudes have a higher tendency to use transit at all disutility values; however, caution must be used in interpreting these attitudinal data. Some of the people may be using transit for reasons not related to attitude but may be exhibiting a positive attitude to rationalize their

**Figure 3. Busway ridership trends.**

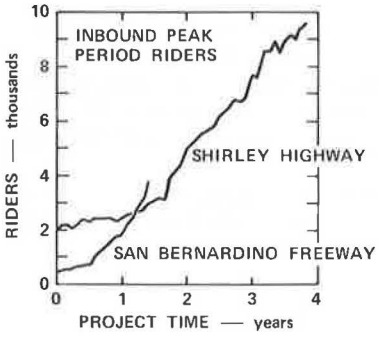



**Figure 4. Check of modal split model.**

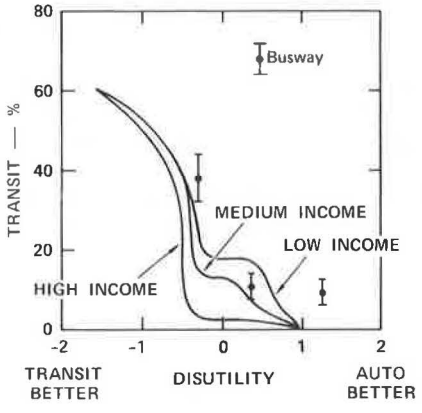
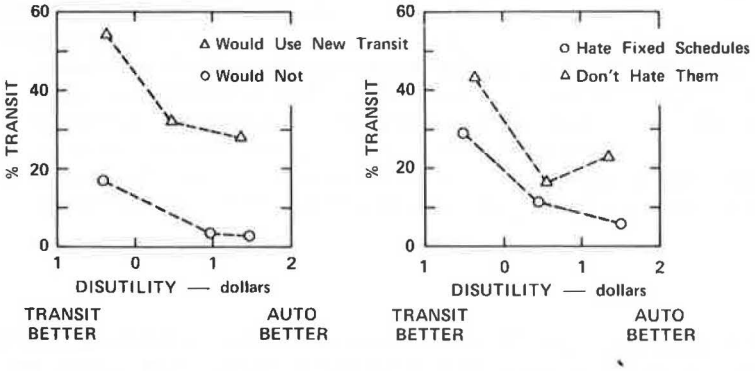



**Table 2. Commuter profiles.**

| Description | Automobile Users (percent) | Busway Users (percent) | Prebusway Transit Users (percent) |
|---|---|---|---|
| Female | 51 | 52 | 65 |
| Income < $10,000 | 21 | 18 | 54 |
| Over 40 years | 40 | 36 | 55 |
| Cars per household ≤ 1 | 25 | 40 | NA |

**Figure 5. Modal split versus attitude.**



commuting behavior. Some of the people responding negatively to the first attitudinal statement are not exhibiting an attitudinal response but are explaining that they cannot use transit regardless of its qualities (they must take their cars to work because they use them during the day). Twenty-four percent of the automobile commuters interviewed claimed they needed their car at their place of work.

Notwithstanding these reservations on the meaning of the attitudinal data, attitude is a major factor in modal split, and much more research is needed in this area, particularly as it relates to marketing transit.

### Busway Compared With Rail Rapid Transit

The comparison of the busway and rail rapid transit is critically important to southern California because of the required large investment costs for rapid transit. It is premature to draw this busway-rail comparison, but at this point it is clear that this particular busway does not appear to be inferior to rail rapid transit in its ability to attract passengers. This statement cannot be generalized to other busways. The success in patronage growth of this busway must be noted relative to (a) the type of service provided (suburb-to-downtown), (b) the demand level, and (c) the comparatively large transit market share traditionally enjoyed by SCRTD in this corridor.

## FUTURE PHASES

We have now completed phase 1 of the busway experiment, exclusive use by transit vehicles of the partial busway. Phase 2 will commence when the completed busway with all three stations becomes operational in September 1974. Buses will continue to be the sole user of the busway during the 2-year phase 2 program. In the 3-year phase 3 program, the current California DOT-SCRTD agreement calls for experimentation in which car pools are metered for travel on the busway lanes.

The final plans for phase 3 as well as decisions on the use of the busway concept in other Los Angeles corridors and in other corridors throughout the nation will depend on the continuing findings of the San Bernardino Freeway Express Busway evaluation.