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2008 Bus Rapid Transit
Vehicle Demand & Systems Analysis Update

August, 2008

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BRT
BUS RAPID TRANSIT

2008 Bus Rapid Transit
Vehicle Demand & Systems Analysis

August, 2008

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13. ABSTRACT (Maximum 200 words) **The objective of this report is to reflect the state of the U.S. market demand for "BRT-heavy" vehicles and systems, with a focus on "BRT-heavy" vehicles and systems. It is the third is a series of market demand analyses and as such, charts the trends in this evolving market. Via phone interviews and electronic surveys of transit planners, and also via published reports from the transit properties and industry publications, the report compiles data about the quantities of vehicles, delivery timing, and vehicle preferences such as vehicle type, length, propulsion, image, and appearance, as well as supporting technologies such as signal priority. An aggregate view is developed about the features in BRT vehicles and systems implied by the community transit plans now and in the near future. Implications are drawn from the community interviews and analysis results. What emerges is a perspective on the vehicle features desired to support BRT plans, the quantities and timing of vehicles with these features, and a set of proximate topics that may be important for future industry dialog.**

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Foreword

The FTA intends to identify effective ways to encourage the supply of vehicles made in the United States to BRT communities. At the request of industry stakeholders, an analysis characterizing the U.S. demand for vehicles suitable for use in BRT systems was published in 2002, with an updated edition published in 2004. This analysis is the third in this series of reports, all of which are part of the Federal Transit Administration's Bus Rapid Transit Action Plan. This report intends to reflect the state of the U.S. market demand for "BRT-heavy" vehicles and systems, based on the known or published plans.

This work documents data captured from public documents, websites, and transit-industry sources, as well as from direct interviews with the designated transit property planners about their plans for implementing BRT corridors. The results drawn from the compiled information describe the quantities of vehicles, delivery timing, and vehicle preferences, examples of which include vehicle type, vehicle dimension, propulsion, appearance, and supporting technologies such as signal priority, cashless fares, and other infrastructure. The results are based on aggregating the industry-provided data covering the period from 2007 through 2016.

The intent of the document is to assist both the manufacturing and the customer sides of the transit bus industry by providing a ten-year compilation of projected trends.

Notice

Preface

This report was prepared by CALSTART, Inc. The data contained in this report include planning information that carries a degree of uncertainty. While this information reflects current thinking of transit properties relative to Bus Rapid Transit, the specific quantities, timing and preferences identified may change in the future.

Acknowledgements

The report was sponsored by the Federal Transit Administration (FTA), Office of Mobility Innovation. CALSTART would like to acknowledge the contributions that made this report possible. The study was conducted through electronic interviews, telephone interviews, email questionnaires, and reviews of public documents provided by participants, websites, and other public sources. The authors would like to express their sincere appreciation to the many people who made time in their busy schedules to provide their insights, data, and observations that are the heart of this report.

The participants included FTA officials, community transit representatives, and other industry stakeholders. All participants contributed valuable information, ideas, suggestions, viewpoints, and perspectives on BRT plans and topics. CALSTART paraphrased comments, aggregated data, and compiled numbers to profile the community demand and perspective on vehicle preferences. CALSTART also appreciates the reviews and clarifications provided by the participants.

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1.0 INTRODUCTION

This brief section introduces the concept for the analysis results documented in the report, the intended uses for that data, and the organization of the data into sections and subsections.

1.1 About the 2008 Bus Rapid Transit Vehicle & System Demand Analysis Update

The FTA intends to identify effective ways to encourage the supply of vehicles made in the United States to BRT communities. At the request of industry stakeholders, an analysis characterizing the U.S. demand for vehicles suitable for use in BRT systems was published in 2002, with an updated edition published in 2004. This analysis is the third in this series of reports, all of which are part of the Federal Transit Administration's Bus Rapid Transit Action Plan. This report intends to reflect the state of the U.S. market demand for "BRT-heavy" vehicles and systems, based on the known or published plans.

This work documents data captured from public documents, websites, and transit-industry sources, as well as from direct interviews with the designated transit property planners about their plans for implementing BRT corridors. The results drawn from the compiled information describe the quantities of vehicles, delivery timing, and vehicle preferences, examples of which include vehicle type, vehicle dimension, propulsion, appearance, and supporting technologies such as signal priority, cashless fares, and other infrastructure. The results are based on aggregating the industry-provided data covering the period from 2007 through 2016.

The intent of the document is to assist both the manufacturing and the customer sides of the transit bus industry by providing a ten-year compilation of projected trends. In the last two BRT Vehicle Demand Analyses, the research was keyed on a small group of leading BRT organizations since the BRT industry was far less mature than it is now. Because of the rapid growth of this industry across the country, the researchers at CALSTART decided it was no longer necessary to survey every organization that could be called "BRT", but rather, to focus on those which would be the leaders in the field.

According to the Transit Cooperative Research Program, the best way to achieve time savings in BRT systems is to utilize exclusive right-of-ways and spacing between stations.[1] Thus, for the sake of this document, we came up with two designations predicated by the use of exclusive right-of-ways:

- "BRT-heavy" is a phrase that we used to define the BRT systems that use dedicated right-of-ways. "BRT-heavy" systems often utilize several other BRT elements, like off-board ticketing, queue jumps, and signal priority.
- "BRT-lite" systems are any systems that lack these dedicated right-of-ways and often use fewer of the BRT elements.

Thus, two surveys were performed: one to take a snapshot of the BRT industry as a whole (to include both the "BRT-heavy" and "BRT-lite" systems), and another to focus on the organizations that were pursuing "BRT-heavy" systems.

It was apparent from the previous two analyses that BRT in the United States has been growing and evolving quickly, and as such, it may be difficult to define at this moment. Thus, the purpose of the snapshot was to provide a general understanding of the greater trends across the sector. The two previous vehicle demand analyses focused on BRT as a whole since the number of BRT communities was far

[1] Levinson, H., S. Zimmerman, J. Clinger, S. Rutherford, R. Smith, J. Cracknell, and R. Soberman; Transit Cooperative Research Program, *Report 90: Bus Rapid Transit, Volume I: Case Studies in Bus Rapid Transit.* Summary, Section 7: "Implications and Directions" (page 8). Transportation Research Board. 2003.

smaller at that time and "BRT-heavy" systems were not being planned in high frequency. Now that the BRT sector has grown to an extent and different levels of BRT have begun to emerge, this report focuses on "BRT-heavy" organizations, because we believe that these now foretell the overarching directions of the transit bus industry. Just as a general survey of the BRT community was appropriate four years ago, we believe that a focus on "BRT-heavy" communities is appropriate now.

For manufacturers, the report's data may assist in setting in-house priorities and even investment decisions regarding the continued development of technologies that support the features in vehicles that the transit properties feel are necessary for future BRT service. For public agencies, this data provides a composite view of the U.S. BRT status and a glimpse into the future. It should help manufacturers fill the gaps in BRT product availability in the US while facilitating the decision-making process for bus manufacturers.

In support of such a goal, transit properties were interviewed and provided questions and issues that would make the data contained in this report of greater value to their decision-making. Exhibits and tables are designed to respond to those decision-making needs. It must be noted that this report is not intended to provide information for near-term marketing, sales leads, or forecasts to the industry but rather, to seek an indication of the industry's needs.

1.2 About the Organization of this Document

The document is organized to describe the results of the two phases of the survey in order. Phase I is a broad survey to determine the larger trends across the US BRT community. It examines the number of communities, their plans for BRT infrastructure, their vehicle preferences, their fuel preferences, and their propulsion systems. It also takes a sample of the interest in guidance technology.

The second half of the document focuses on Phase II, which was a survey of 17 "BRT-heavy" communities in the United States. It examines the historical BRT timeline and analyzes where "BRT-heavy" fits in as a part of the U.S. BRT community. It then examines the vehicle delivery numbers in terms of length, fuels, propulsion systems, aesthetics, guidance, and the migration of the higher level elements to regular bus service to determine the impact that "BRT-heavy" will have and to examine the future direction of bus service in the U.S.

2.0 SUMMARY OF MAJOR FINDINGS

This section highlights the purpose and approach to the analyses, and then summarizes the principal findings from the contacted communities.

2.1 Analysis Purpose and Approach

The intent of this work is to update the analysis of vehicle and system preferences for BRT communities published in 2002 and 2004. The 48 communities that were contacted for the 2004 edition were again contacted for this one, with another 28 added, making a total of 76 that were contacted for this analysis. Of those communities, 63 responded to the general inquiry on the industry, providing the data to choose the 17 that were interviewed for the "BRT-heavy" section of the analysis.

The purpose of this document is to reflect the current market demand preferences for BRT vehicle characteristics and to some degree, the systems. The strength of a feature preference is measured as a percentage of vehicles planned with that feature versus the total quantities (expected to be) delivered over that ten-year period, 2007 through 2016. This approach involved researching public documents and amplifying that information with interviews of planners at the selected communities.

As previously mentioned, for the first phase of the work, a broad survey was performed on possible U.S. BRT communities and their systems. Because of the large number of BRT communities, the most effective data gathering method would be done via electronic survey. Thus, we contacted the transit organizations that were planning, implementing, or running BRT systems and asked them to take our survey. It's important to note that with different versions and names for advanced bus and BRT systems, it did not matter whether a system was called "BRT" or not by its planners. Instead, the transit organizations selected the BRT-like elements that they were planning on implementing, which would allow our researchers to use that data to isolate those that would possibly fit under a "BRT-heavy" category within 10 years. The data sets from the 63 respondents were used to narrow the list of planned/existing "BRT-heavy" communities and chose 17 to perform the second phase of our survey, which consisted of phone interviews to gather data from each of the "BRT–heavy" communities.

Via research and discussion with transit planners, we identified 11 potential BRT elements in total for our first survey. For the purpose of the document, we've grouped them into four informal categories: infrastructure, intelligent transportation systems, land use/transit oriented development, and vehicles. We will not present on TOD/land use for this report. Please note that for Phase I, these data sets are expressed in terms of total number of BRT communities and not total number of vehicles.

Below is a list of the four groups that were used and their categories:

1. Infrastructure
    - Exclusive right-of-ways
    - Peak Period Dedicated Bus Lanes
    - Queue Jumpers
    - Limited Stops
2. Intelligent Transportation Systems
    - Signal Priority
    - Real-time Passenger Info
    - Off-board fare collection
3. TOD/Land Use
    - Improved station areas
    - Transit oriented development (TOD)
4. Vehicles

- Uniquely designed vehicles
- Low-floor boarding

2.1.1 Communities Contacted

As in the previous BRT Vehicle Demand Analyses, the communities that were selected for the analysis were based on FTA guidance and research from outside sources, including industry contacts and published reports on the Internet. However, unlike the previous reports, the approach here was to analyze not only the vehicles, but the general BRT systems overall, since these are as much -- if not more so -- a part of the effectiveness of this form of rapid transit. Information has been compiled from a majority of the 63 communities; however, some did not have their plans sufficiently developed to provide information on vehicle preferences for this analysis.

2.2 Major Findings

2.2.1 Key findings of Phase I

Some of the highlights of the major findings of this broad survey (both "BRT-heavy" and "BRT-lite" systems) include these results plus subsequent data and analysis:

- A significant increase in the implementation of "BRT-heavy" attributes.
- The number of new communities implementing BRT service corridors is growing at a rate of at least three per year.
- There are significant plans to increase the number of dedicated lanes for BRT.
- Substantial interest exists in specialized vehicles.
- The lack of readiness and availability of guidance technology is depressing its demand.

2.2.2 Key findings of Phase II

- A strong and consistent rate of "BRT-heavy" implementation will begin in 2010.
- Although there is a strong long-term trend for articulated vehicles, the transit agencies were presently ordering more forty-footers than sixty-footers.
- There is strong growth in plans for biodiesel.
- Hybrids are overtaking internal combustion engines for "BRT-heavy" systems.
- American BRT vehicle design has improved in recent years but a significant percentage of these communities would still prefer more of a bullet train or Civis/Wrightbus aesthetic.
- Significant demand exists for tail design but is not being met.
- Because of the migration of BRT elements into non-BRT systems, "BRT-lite" may become the de facto bus system in the future.

3.0 ANALYSIS PLAN

This brief section defines the goals, scope, and methods used to collect, compile, and analyze the data from transit communities in some stage of planning a Bus Rapid Transit service in one or more corridors. Subsection 3.1 deals with the analysis goals and approach used to capture the data including the sources. The following subsection 3.2 provides the objectives for compiling the data into charts and graphs to illustrate trends.

3.1 BRT Vehicle Demand Analysis Goals and Approach

The number of communities pursuing Bus Rapid Transit service implementation has been steadily increasing since 1998. The specific goal of the community analysis task is to compile information that reflects each transit property's BRT corridor plans and strategies for ten years, 2007 to 2016. This task accumulates the available information by identified BRT corridors for the topics shown in the Table 1.

Table 1: Community Analysis Goals: Capture BRT Plans and Vehicle Information

• Quantities of vehicles – by community
• Vehicle delivery timing – by community
• Vehicle characteristics – by dimensions, propulsion, fuel, style, and image
• Supporting technologies and infrastructure – by community vehicle guidance, lane/right-of-way, etc…

The results are a bottom-up industry-based projection using the sources as identified in Table 2. For the most part, these data are based on personal interviews and refined through published information. Personal interviews of planners guide the selection of the most pertinent documents and assist in researching key information. The intent is to measure key characteristics about the BRT vehicle and systems markets that can assist in evaluating the business case for future vehicle technologies.

As shown in Table 2, a variety of documents may be available depending on the stage of planning that a community has reached for its BRT corridor(s). Early in the process, long range plans are developed and then progress to major investment studies, scoping studies, environmental impact statements, and ultimately to locally preferred alternatives, which are followed by engineering studies. The interview process with key planners within each community or transit property helps sort through these many documents and ultimately provides a perspective on the latest thinking from all local stakeholders involved in the community planning. However, no matter how firm the plans appear at the time, they do change, so the individual data by community are aggregated to a nationwide number or preference to provide a more robust set of findings.

Table 2: Sources of Data

• Long range transportation study and plans documents
• Draft and final environmental impact statements (EIS)
• Documents describing locally preferred alternatives
• Workshop papers, websites, newsletters, public Reports
• Personal interviews with transportation planners

3.2 Demand Analysis Objectives

The objective of capturing these data is to provide a perspective on the quantities and preferences in vehicles that the "BRT-heavy" communities desire to complete their BRT plans. The quantities of 60-65' articulated buses, 40-45' and 30-35' buses planned for delivery (when they are needed for service, usually by year) are put into spreadsheets by corridor. In the short-term projections, these quantities and the delivery dates may result from the communities being in a proposal or contract stage and in the long-term

projections, they relate to revenue in-service dates. These annual delivery numbers are cumulated year-by-year to provide a total for the ten-year period, although if a community's numbers become highly vague, they are not included in order to keep the projections realistic. For example, if in seven years from the date of the survey, the community's projections are unclear as to whether it will be ordering 40-45' vehicles or 60-65' vehicles, then the numbers are not included for either vehicle length since they would dramatically distort the trends if incorrect.

For Phase I, the preferences are expressed in terms of total number of communities. For Phase II, they are largely expressed in terms of a percentage of vehicles with that characteristic based on the communities' plans aggregated from the sources in Table 2. The data are cast in charts to suggest the trends in the size and character of the BRT demand for vehicles with specific features to be able to contrast and compare. The specific data objectives for the formulation and presentation of these data are listed in Table 3 and include such items as propulsion, fuels selection, and appearance by vehicle type. Other pertinent preferences suggested by the communities are detailed, such as interest in lane assist or docking guidance and other ITS technologies. BRT support technologies such as the percentage of communities pursuing transit signal priority or cashless fares and other infrastructure are also plotted. Finally, there are observations about relationships within the results that are developed during the analysis that is used to derive implications for the industry and Bus Rapid Transit.

Table 3: Community Analysis Objectives for Results

- Aggregate the number of vehicles planned for delivery each year from 2007 to 2016, by type – based on transit property planning
- Cumulate potential vehicle deliveries by type (2007-2016)
- Quantify demand for specific vehicle characteristics (propulsion, fuel, doors, floors and appearance), by vehicle type – as a percentage
- Identify and quantify, by communities, specific BRT support technologies and infrastructure
- Make observations and derive implications from the results

4.0 PHASE I ANALYSIS RESULTS

4.1 BRT on an International Level

Bus Rapid Transit ("BRT") was first implemented in Curitiba, Brazil in 1974 under the auspices of Mayor Jaime Lerner as an affordable alternative to rail transit. Today, Curitiba's system carries over two million passengers per day and is regularly used by more than a third of the city's population.[2] Since that time, BRT has spread across various countries in Latin America and is perhaps best exemplified in Colombia, where Bogotá's TransMilenio has decreased the average travel times for transit users by 32 percent and dramatically improved the quality of service.[3] To the individual transit user, this equates to a time saving of around 16 minutes per trip.[4] By 2015, TransMilenio is projected to transport approximately five million people a day. Not only has TransMilenio replaced a chaotic and inefficient transit system with a futuristic, efficient, and streamlined one, it has actually facilitated the development of the city's parks and cycle paths in a coordinated system, as it's far more than a mere transportation project. According to a report by EMBARQ, "it became a system that developed the city's technical, institutional, financial, and social capacities."[5]

Although the original Brazilian model is expanding most rapidly in Latin America, Asia, and Oceania, a form of it has spread across Europe and is catching on in Canada and the United States. BRT is now spreading around the world. Figure 1, courtesy of EMBARQ, provides a general idea of the countries with planned and existing BRT systems as of October, 2006.[6]

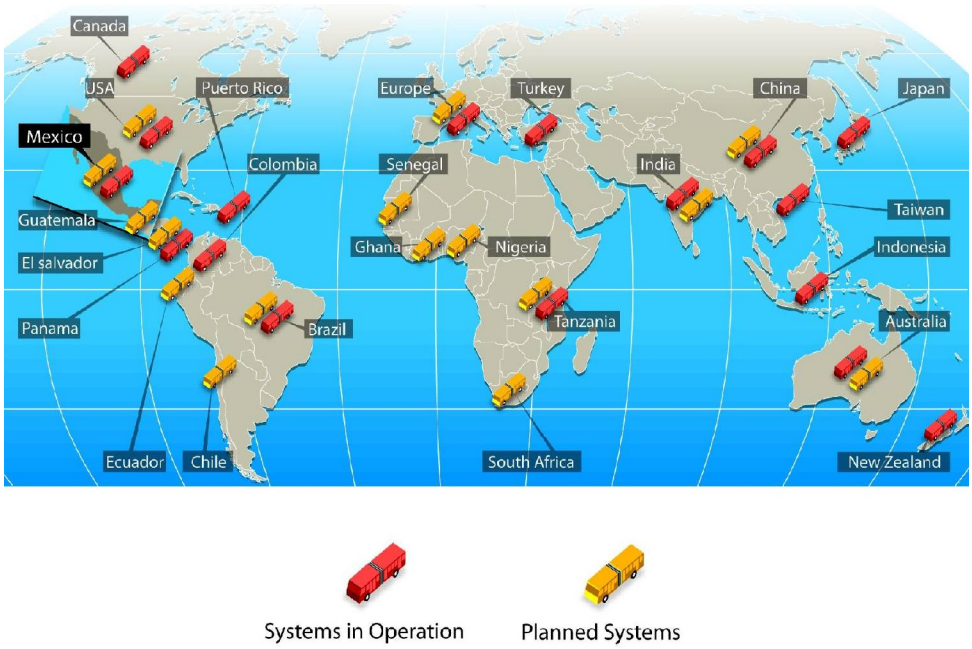

Figure 1: Countries with BRT systems planned and in operation (October, 2006**)**

[2] "Bus Rapid Transit: Arriving on the World Scene"; *Sustainable Mobility: A publication of EMBARQ and the Center for Sustainable Transport in Mexico*; page 18; October, 2006.
[3] "Applicability of Bogotá's TransMilenio BRT System to the United States; National Bus Rapid Transit Institute; page 34; May, 2006.
[4] Ibid.
[5] "Bus Rapid Transit: Arriving on the World Scene"; *Sustainable Mobility: A publication of EMBARQ and the Center for Sustainable Transport in Mexico*; page 21; October, 2006
[6] Ibid, page 19.

4.2 BRT Communities in the United States

As previously mentioned, in the 2002 Vehicle Demand Analysis, 28 U.S. communities were contacted. In the 2004 update, 48 were contacted and now in the 2008 update, 76 communities have been contacted with responses from 63. From these 63 responses, we expect at a minimum, 60 BRT communities to be in existence by 2017. Please note that these communities may have multiple BRT corridors, but for the sake of this project, each community is counted only once. As Figure 2 shows, over the next ten years, a minimum of three new BRT communities should come on-line per year on average, whether they are self-defined as BRT or not. Additionally, we found that BRT elements are quickly spreading to non-BRT communities and corridors.

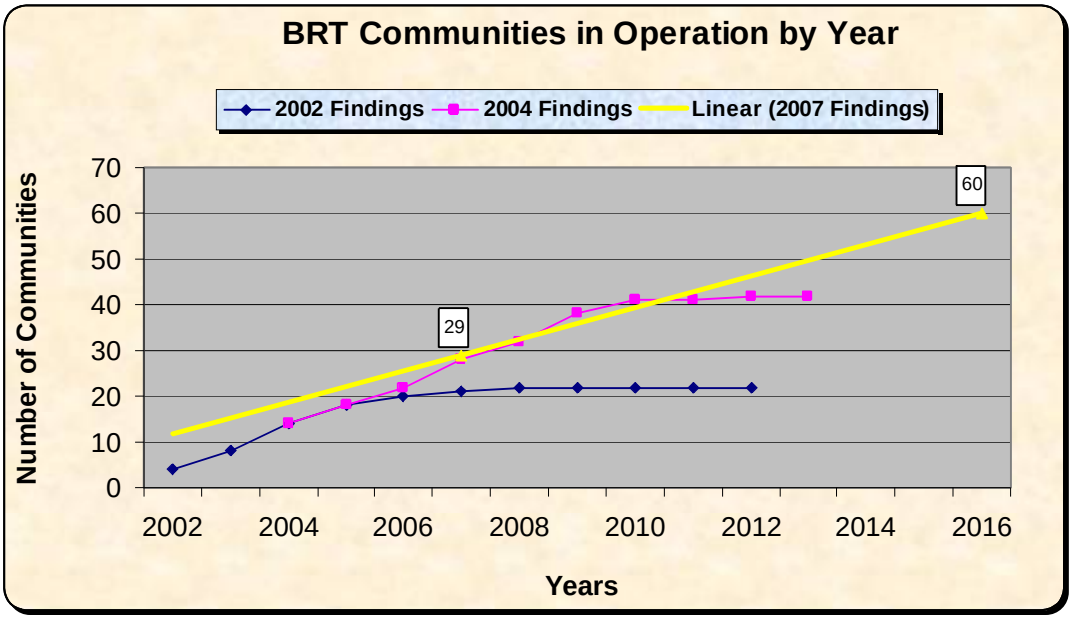

Figure 2: U.S. BRT Communities (2007-2016)

In the previous two updates, the average of new BRT communities was approximately four to six per year, and one can see from our linear projection for the 2007 findings that an average of three per year is expected (29 communities in 2007 and 60 by 2016). One will note that this is a conservative estimate, since only 63 of the 76 communities responded. It is difficult to gauge which of the remaining 13 communities might achieve BRT status without their responses. Additionally, it is expected that the unpredictability of transit funding could signify an increase or a decrease in actual planning and implementation within the next 10 years.

Note: for Phase I, the data are expressed in terms of the total number of BRT communities; not in terms of the total number of vehicles. For Phase II, the data will be expressed in terms of vehicle numbers and percentages.

4.3 "BRT-heavy" communities

For the sake of the first survey, "BRT-heavy" was defined as any BRT system having a dedicated BRT right-of-way. This is clearly not a "full BRT" definition, but it is important to differentiate between the two since there is still a lack of "full BRT" systems (i.e.: Curitiba and Bogotá) in great numbers in the United States.

Of the BRT elements that were chosen for this survey, the average number of elements per surveyed transit community in 2007 was 3.5. However, by the end of 2016, the average number per surveyed community is expected to increase to 7.6, which is more than twice the current number. This allowed us to focus on the communities which would have enough of the "BRT-heavy" elements in their entire bus system to perhaps have a "BRT-heavy" line planned for implementation. The final number of communities with enough elements in their system by 2017 to possibly be "BRT-heavy" was 39, which was more than twice as many as the 17 in 2007 which either had these elements already or had plans for them. Taking those numbers, we interviewed 17 of the 39 that were potential "BRT-heavy" communities for Phase II of our analysis.

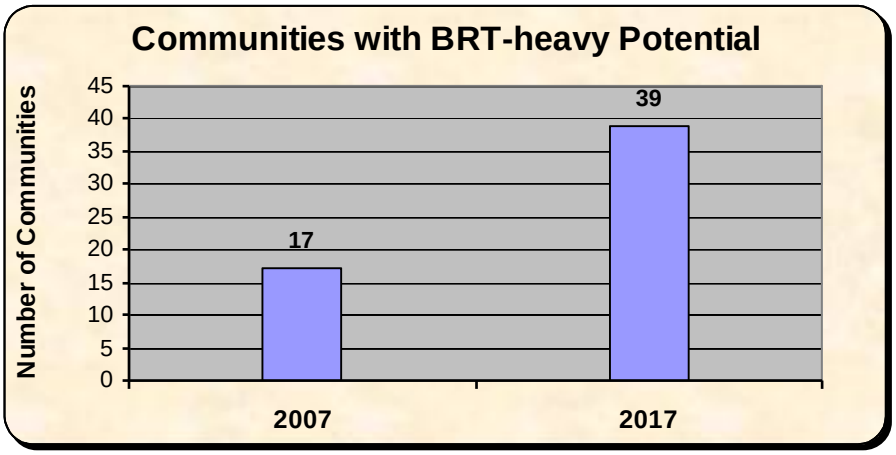

Figure 3: Number of surveyed communities whose systems had the planned elements to be considered for Phase II.

Regardless of whether each of the 39 communities eventually implements a "BRT-heavy" system or not, the significant increase in the number of communities that are planning for so many of these "BRT-heavy" elements in their overall bus transit systems is a strong indicator of serious investment by these communities in rapid transit service.

4.4 Planned BRT Infrastructure

Proper BRT infrastructure is the key ingredient to increased travel speeds. The respondents were asked about their plans for four BRT infrastructure elements: exclusive right-of-ways, peak period lanes, queue jumpers, and limited stops. As one can see from Figure 4, there will be a dramatic increase across all four elements. The number of communities with exclusive right-of-ways (in their overall transit system) will more than double from 17 to nearly 40. The communities with peak period lanes will almost triple; those with queue jumpers will more than double, and those with limited stops will also double. In fact, of the 63 respondents, 89% plan on implementing limited stop service by 2017, making it nearly universal. The reasons given were simple: it's faster and less expensive than regular service, so it can be easily added as an overlap to existing bus service.

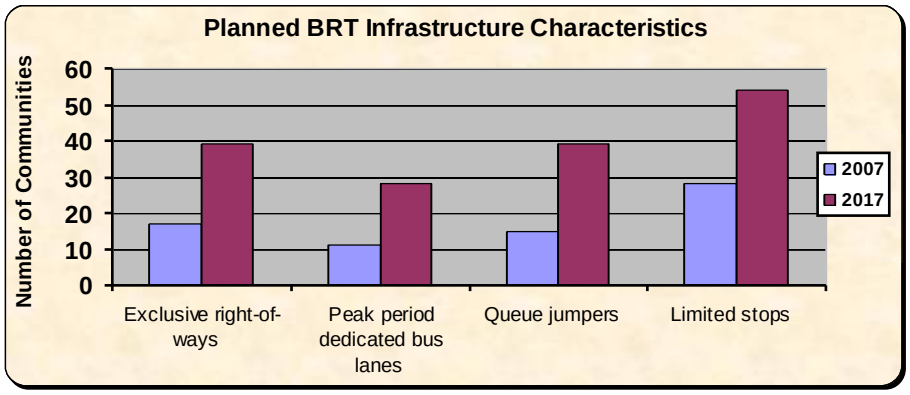

Figure 4: Plans for BRT infrastructure

4.5 Planned Intelligent Transportation Systems ("ITS")

Respondents were also asked about their plans for ITS elements: signal priority, real time passenger information, and off-board fare collection. Again, there were tremendous increases across all three elements. Both signal priority and real-time passenger information should become nearly universal in BRT communities within the next 10 years, as signal priority may increase from 38% to 92% (increasing from 23 communities in 2007 to 56 by 2017). Real-time passenger information will make a similar increase, and off-board fare collection should jump from 6 communities in 2007 to 33 by 2017, increasing from 10% to 54%.

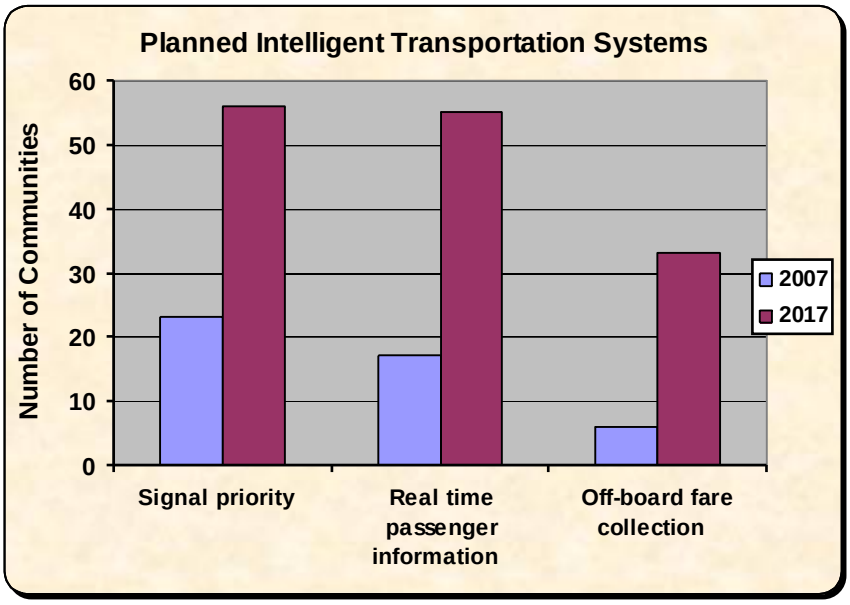

Figure 5: Planned ITS

4.6 Alternative Fuels and Advanced Propulsion Systems

Many of the surveyed communities were preparing to use ultra-low sulfur diesel as mandated by the EPA[7], or were already using it at the time they answered the questions. However, among the

[7] Mandated as of October, 2006 ("Fuels and Fuel Additives, EPA web site: http://www.epa.gov/otaq/regs/fuels/diesel/diesel.htm)

communities planning on using alternative fuels and advanced propulsion systems, hybrid-electric vehicles were the most significant at 40% of all the surveyed communities at the time of Phase I. Compressed Natural Gas vehicles were the second most common at 31%. Also, bio-diesel has become far more common than it was just four years ago, when it did not register on the scale in the 2004 update for articulated vehicles. Now, it is in the plans for 12% of the surveyed communities, and it's likely that, because of the timing of this portion of the survey before the certification of B20 among the engine manufacturers, that this number may have increased since. Additionally, whereas fuel cell buses were not even in existence four years ago, they are now in trial/pilot project service, albeit in a few locations so far.

It's clear that the pace of change is very fast and very strong right now due to many outside factors (i.e.: the aforementioned certification of B20, the demands of energy security, the ongoing development of hybrid-electrics, etc…). As experience with hybrid-electric vehicles and biodiesel continues to grow, the numbers of BRT communities willing to invest should further increase in these two areas. In fact, the data for the second part of the survey, Phase II, which was performed months after this one, are quite different in terms of both of these areas, especially due to the fact that B20 reached certification from the engine manufacturers after Phase I. At this point, the transit properties' experiences with biodiesel and HEVs are still new, so there could be even further shifting on the way.

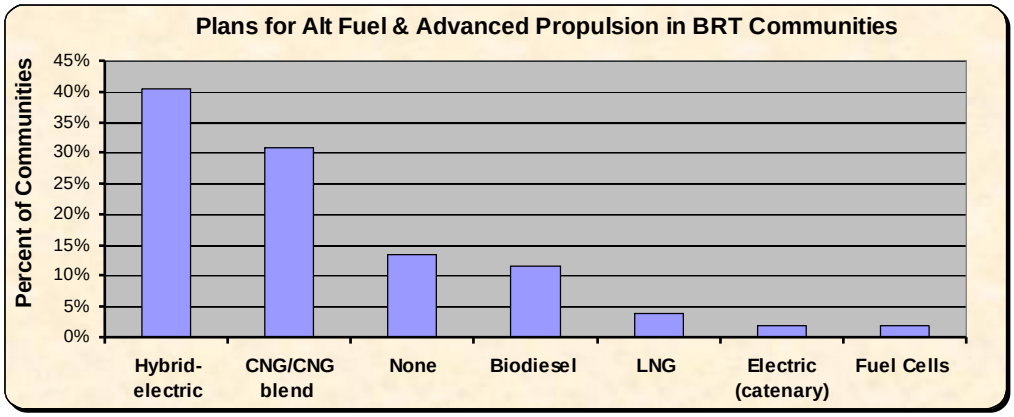

Figure 6: Plans for alternative fuels and advanced propulsion vehicles

4.7 BRT Vehicle Styles Planned/Existing Orders

In terms of the actual BRT vehicle styles, the five categories included in the survey were taken from the Characteristics of Bus Rapid Transit for Decision-Making ("CBRT"), including conventional standard, stylized standard, conventional articulated, stylized articulated, and specialized vehicles.[8] To summarize, there are three styles of BRT vehicles: conventional, stylized, and specialized. The conventional and stylized vehicles can be ordered in either standard (40'-45') or articulated (60'+) lengths, so they are broken out into those two areas, creating the five aforementioned styles. To be brief, the conventional vehicle can be described as the original rectangular bus shape. The stylized shape is more rounded (i.e.: the NABI 60 BRT), and the specialized vehicle resembles a light-rail vehicle on wheels (i.e.: the Wrightbus Streetcar).

[8] A brief explanation of each of each of the vehicle styles can be found in section 2.3.2 of the *CBRT*.

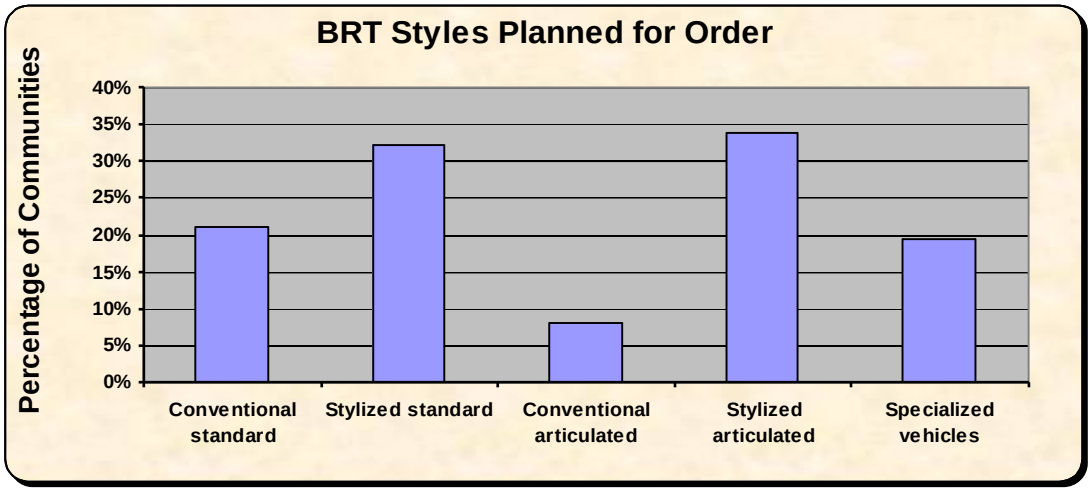

Figure 7: BRT vehicle styles

The results were somewhat predictable in that the stylized vehicles were the leaders in existing/planned purchases for the surveyed BRT communities. Additionally, BRT communities had a greater interest in larger vehicles than in smaller ones, which could also be expected due to the high densities being served in their corridors. However, there was an unexpectedly large number of communities claiming plans for ordering specialized vehicles (i.e.: the Civis), which are not yet made in the United States and would require avoiding the "Buy America" requirements. It's also possible that, even though illustrations of each vehicle type were provided, planners may have been biased in selecting specialized versus stylized vehicles, given their similarities. The classification is relatively new (2004) and the difference between the two categories may be narrowing over time.

4.8 Planned Orders Contrasted to Preferred Orders

The survey then asked the communities which styles they would prefer to order, assuming they had the funding and the vehicles were more readily available. Although the question's parameters were a little idealistic (i.e.: sufficient funding), the purpose was to gauge the difference between the actual demand versus the ideal demand: what the communities are ordering because of political and fiscal constraints versus what they'd really like to order. The idea was to provide a clearer picture to the industry on what the transit agencies actually desire.

The most salient trend was the tremendous shift on either end of the chart: the interest in conventional standard vehicles decreased almost to nothing (from 18% to 2%) while the interest in specialized vehicles rose from 17% to 39% (see Figure 8). Everything in between remained relatively unchanged, which shows that the interest in planned orders versus preferred orders are approximately the same in the middle. This difference at both ends of the spectrum (decrease in conventional standard vehicles coupled with an increase in specialized vehicles) is important, but the reason for the shift could not be objectively determined.

It must be noted that at this point, there are no U.S. manufacturers that build specialized vehicles. This absence could shift the specialized vehicle demand over to the next closest style, which would be the stylized articulated vehicle.

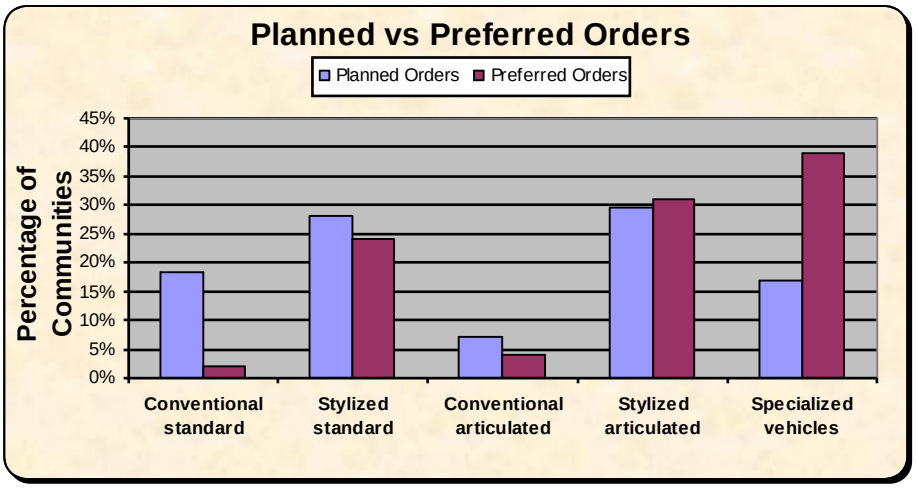

Figure 8: Planned orders versus preferred orders

4.9 Guidance Technology

The communities were also quizzed about their desire to implement vehicle guidance capability for narrow-lane rights-of-way and for docking at stops and stations. As can be seen by Figure 9, only 20 percent of these BRT communities are currently planning for guidance technology.

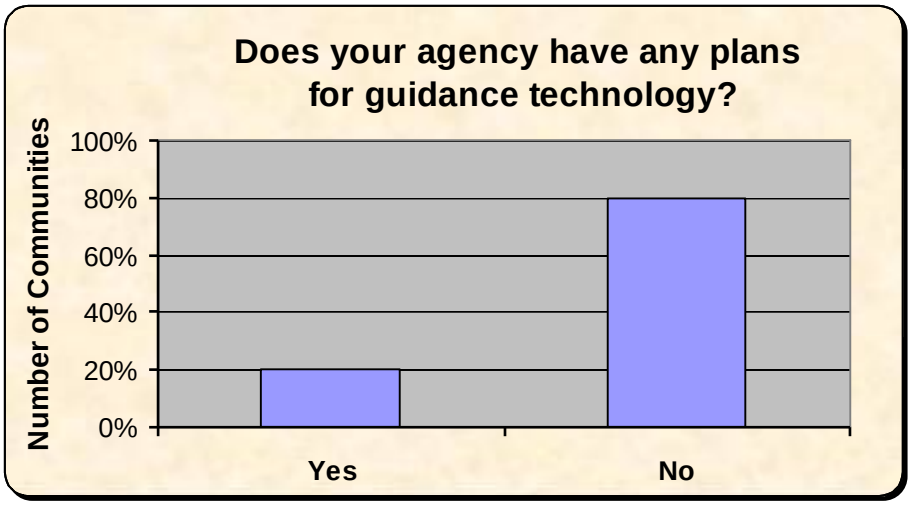

Figure 9: Plans for Guidance Technology

The low number seems to lie in the fact that guidance technology is still unproven and largely unavailable in the United States. That being the case, the interviewees were asked if they would at least consider this technology group if it were available. As can be seen in Figure 10, the result was a significant difference, as 60% would actually consider the technology if it were available already. Thus, the lack of a tested supply in the United States appears to be currently affecting the demand here. The difference between the percentage who are planning for it and those who would actually consider it is 40%.

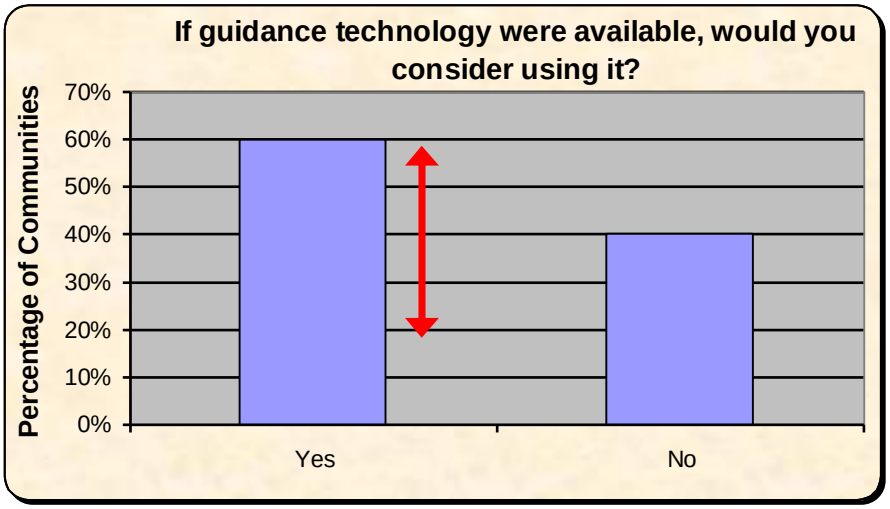

Figure 10: Guidance technology consideration

To reach further clarity on the subject, the respondents were asked which technology they would prefer more, vehicle guidance or precision docking. As Figure 11 illustrates, while communities were interested in both vehicle guidance and precision docking, there was significantly more interest in precision docking over vehicle guidance.

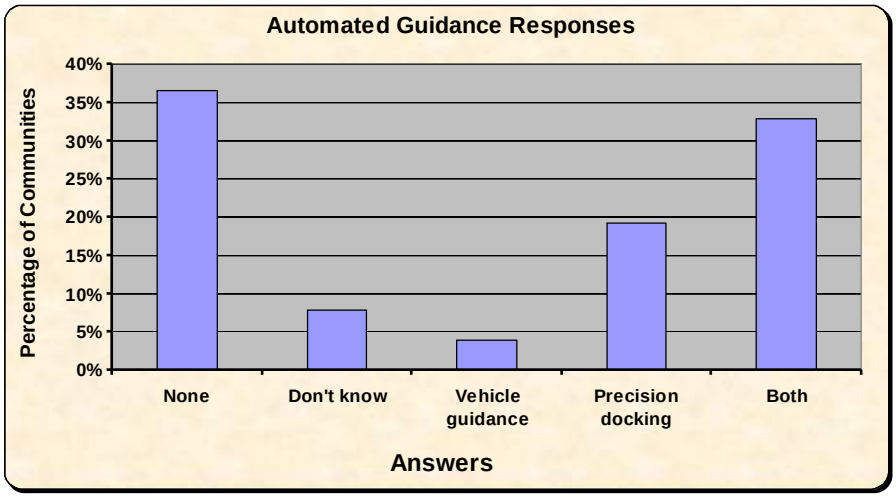

Figure 11: Guidance responses

4.10 Summary of Main Observations from Phase I:

A quick summary of the key observations from Phase I:

1. There is strong growth in the U.S. BRT community, which is scheduled to grow to at least 60 communities by 2017.
2. The number of new communities implementing BRT service corridors is growing at a rate of at least three per year.
3. The number of communities with dedicated right-of-ways is expected to more than double in the next ten years.
4. The lack of readiness and availability of guidance technology is restricting its demand.
5. At least seventy five percent of BRT communities are planning on alternative fuels/advanced propulsion systems.
6. There is a greater interest in stylized vehicles than in conventional ones.

7. There is a significant but unfilled interest in specialized vehicles.
8. The demand for guidance technology would be higher if the technology were available.
9. There is stronger interest in precision docking than in precision guidance.

With the aforementioned doubling in "BRT-heavy" attribute implementation across these bus transit systems, it appears that a lot of BRT elements are spreading easily from "BRT" to non-BRT systems. With the exception of a few extremely expensive elements, the advances in technology and policy that BRT is helping to usher in may eventually make "BRT-lite" ubiquitous. While BRT systems did not necessarily create all of these elements, it seems safe to say that BRT is stimulating already underlying market trends. Thus, it's possible that in the next 15 years or so, there will be no difference between "BRT-lite" and traditional bus service in the U.S.

5.0 PHASE II ANALYSIS RESULTS

5.1 Phase II Methodology

To perform the second phase of the survey, which would focus on the transit communities with "BRT-heavy" systems planned for implementation within the next 10 years, the data from Phase I were analyzed to identify the communities that had enough planned or existing BRT elements to be considered potentially "BRT-heavy" communities. It's important to note that this analysis was performed per system and not per corridor, so the next step involved taking all of the elements within a potentially "BRT-heavy" system and digging deep enough to find actual "BRT-heavy" corridors to research. As mentioned earlier, 39 transit properties met this criteria of being potential "BRT-heavy" systems. Again, we defined a "BRT-heavy" corridor as any corridor with a dedicated right-of-way. We targeted nineteen properties, interviewed them, and kept the data from seventeen of them. Questions were asked regarding vehicle deliveries, fuels, aesthetics, levels of transitway dedication, and other "BRT-heavy" attributes.

5.2 "BRT-heavy" Timeline

Using the updated definition of "BRT-heavy", a brief timeline of U.S. "BRT-heavy" systems entering into operation shows that, in 2003, there were only three communities with dedicated BRT corridors in operation that could be construed as "BRT-heavy". By 2007, there were four more "BRT-heavy" systems in operation, and by 2017, it is expected that at least 17 "BRT-heavy" systems will be in operation in total.

As Figure 12 displays, the growth patterns of "BRT-heavy" communities in 2009 and 2010 will be flat, with no heavy corridors scheduled to be added. However, the average rate of implementation will quickly change to two per year from 2011 through 2014.

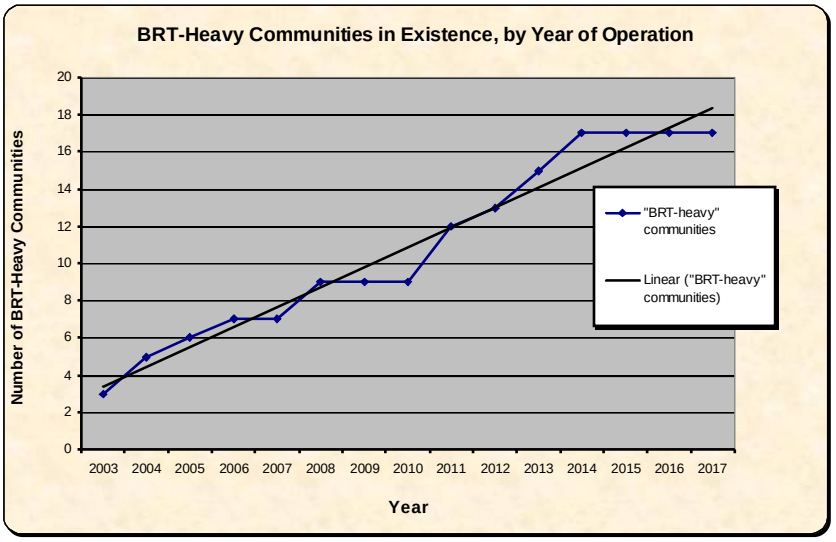

Figure 12: Schedule of "BRT-heavy" System Implementation

This is actually a smaller gap than has been historically present. As one can see in Figure 13, the first "BRT-heavy" community appeared in 1977 while the next one didn't materialize until thirteen years later in 1990. Afterwards, the periods between "BRT-heavy" communities consistently were halved from thirteen to seven, and then again to four and three before populating on an almost yearly basis from 2004 through 2007. One can see that beyond the aforementioned gap of 2008 to 2001, the average rate is scheduled to increase to two per year, if not more. It should be also noted that these are only the communities that are presently planning. Now that the newest generation has been successful, it's quite

possible that several new communities will initiate plans for "BRT-heavy" systems over the remainder of this period and increase the rate even further.

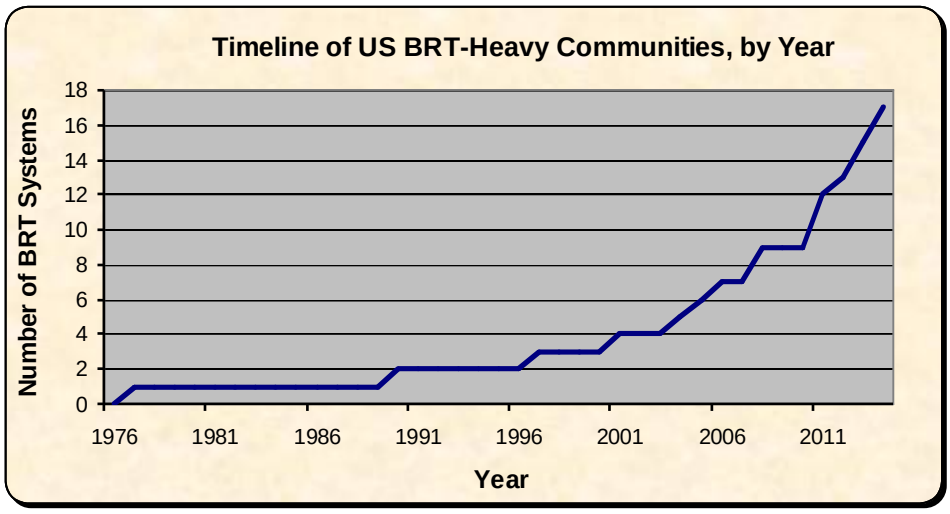

Figure 13: History of US "BRT-heavy" Communities

To put in the greater context of BRT communities in general (i.e.: both "BRT-lite" and "BRT-heavy"), from Figure 14, one can see the trend lines displaying the sheer numbers of "BRT-lite" communities versus the numbers of "BRT-heavy" communities. When comparing the average implementation rate of the two, over the ten-year timeframe, the rate of implementation for "BRT-lite" systems is at least three new systems per year while the average growth for "BRT-heavy" was one system per year.

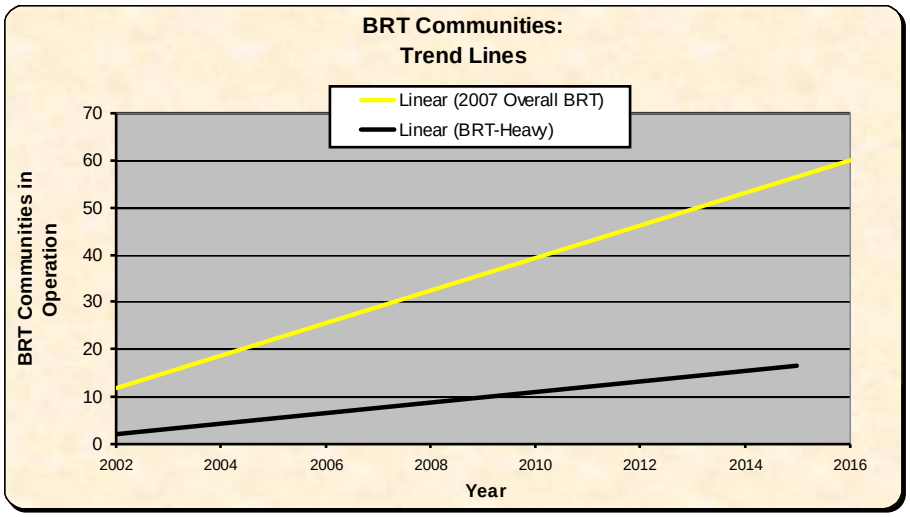

Figure 14: Trend lines for "BRT-lite" vs. "BRT-heavy" communities

5.2.1 "BRT-heavy" Communities as a Percentage of the Overall BRT Community

In the U.S., the original form of BRT was actually "BRT-heavy", but this was before the term was even coined (e.g.: Pittsburgh developed its first busways in 1972) and while other busways came into being, it wasn't until the early 2000's when a new form of BRT, one that began to incorporate a more holistic approach, took off in the United States. As BRT continued to grow and evolve, "BRT-lite" (under other names) became the system of choice. This is likely due to the scalability and affordability of this form of

transit. Thus, the percentage of "BRT-heavy" systems as part of the overall U.S. BRT community has decreased due to the increasing "BRT-lite" investment.

Figure 15 illustrates the implementation of "BRT-heavy" communities as a percentage of overall BRT communities in the U.S. One can see that the initial overall percentage was high, but in the early 2000's, as communities began to invest in "BRT-lite" (i.e.: Metro Rapid), the overall percentage dropped until the year 2011, when it rises again with the increasing rate of implementation of the new generation of "BRT-heavy" communities. Overall, it looks like "BRT-heavy" will attain a foothold in 23% to 32% of U.S. BRT communities in the foreseeable future.

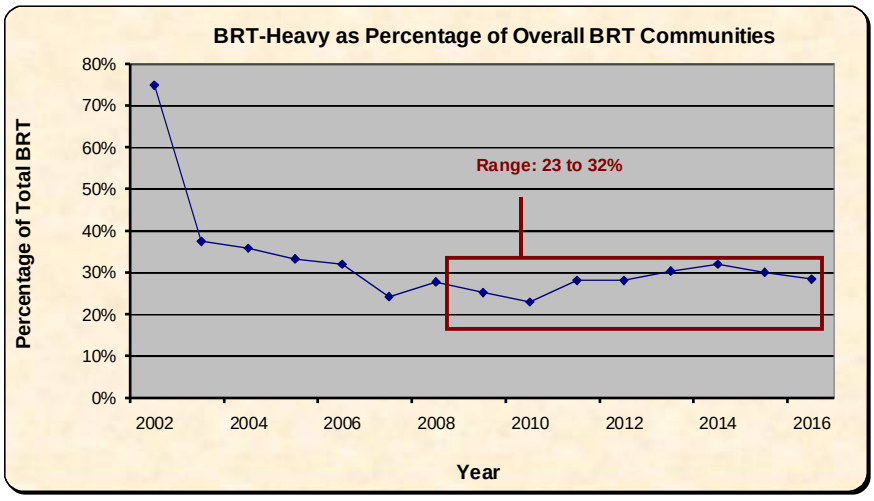

Figure 15: "BRT-heavy" as a percentage of overall BRT communities

5.3 Levels of Dedication for "BRT-heavy"

Each of the respondents was questioned regarding the highest level of transitway dedication it was using in its "BRT-heavy" system. There was only one system that was considered grade-separated. The vast majority of interviewees use at-grade transitways, while one other (New York) had plans for a designated transitway and another two were still to be decided.

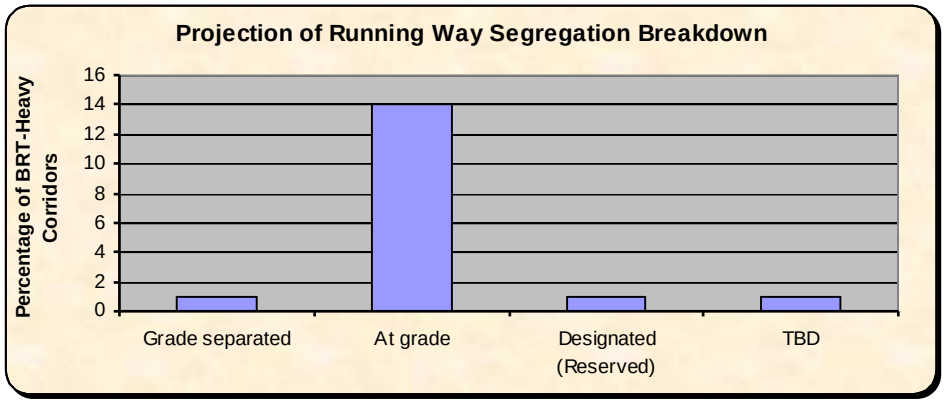

Figure 16: "BRT-heavy" transitway dedication

Because of a lack of funding and difficult political terrain, it is still difficult to get the funding and political willpower to access the money for a grade separated right-of-way. At this point, there does not seem to be a strong demand for grade-separated systems, as the costs of the at-grade systems are

economical when compared to those of grade separation costs. The current solution is the at-grade transitway.

5.4 "BRT-heavy": Vehicle Deliveries

5.4.1 "BRT-heavy" Communities: Total Deliveries, by Length

In the 2004 update, CALSTART found that the majority of the surveyed communities (which include both "BRT-lite" and "BRT-heavy" systems) preferred higher capacity buses over lower capacity buses for BRT. The communities and planners perceived these vehicles as cost effective relative to the capacity increases that were needed.

In this 2008 update, this trend has appeared to change for these "BRT-heavy" communities. Previously, the numbers comparing the deliveries of forty-foot vehicle and sixty-foot vehicles were quite even. However, as Figure 17 illustrates, the projected deliveries for forty-foot vehicles is more than twice that of articulated vehicles (sixty-footers). In the graph, the demand for thirty-foot vehicles is relatively low, which re-emphasizes that BRT is focused on high-capacity transit and that thirty-foot vehicles, while used to feed the system, are not necessarily a large part of the BRT orders.

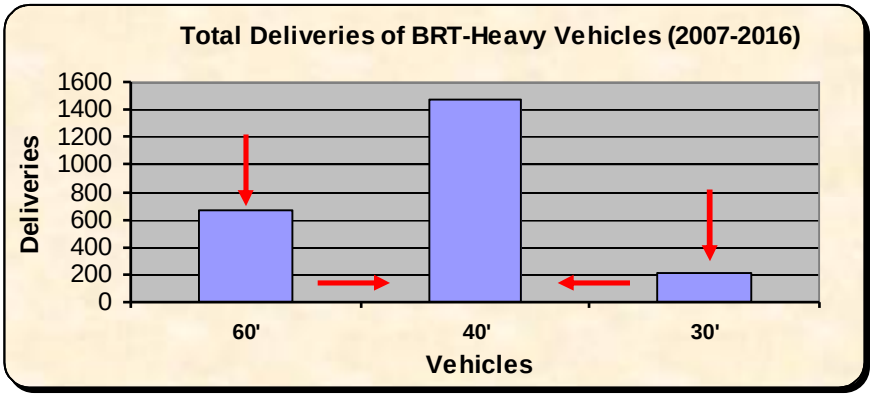

Figure 17: Results for deliveries by length with the two agencies

In the 2004 update, the trend over the 10 years indicated a 63% market demand by 60-65' vehicles, a 22% market demand by 40-45' vehicles, and a 15% demand by 30-35' vehicles. In this, the 2008 update's focus on "BRT-heavy" communities, the percentages were quite different. Instead of a 63% market demand for articulated vehicles, there is only a 31% demand for articulated vehicles (661 vehicles). There is a 69% demand for 40-45' vehicles (1,448 vehicles) with a remaining 10% for 30' vehicles (215 vehicles).

On first glimpse, it would appear that a shift toward forty-foot vehicles has occurred since there is a far greater number of forty-foot vehicles than there is of sixty- or thirty-footers. However, these numbers were strongly influenced by the presence of two particularly large transit agencies, which have been dealing with conditions that were impacting their orders differently than planned. One of these agencies has slowed the orders of its articulated vehicles due to the fact that it is reaching its maximum vehicle storage capacity and cannot fit any more in its barns. While maintaining a strong interest in sixty-foot vehicles, this transit property was considering the upsizing from sixty footers to sixty-five footers to maximize its seating capacity. However, until it extends its storage space or finds a way to construct a new building, it will be forced to limit its stock of articulated vehicles, which artificially creates a shift toward more forty-foot vehicles in the meantime. The other large transit agency that was referred to

above had originally planned on ordering a large amount of thirty-footers to act as feeder vehicles for its "BRT-heavy" corridor, but upon instituting the service, realized that it would have to upsize from thirty-footers to forty-footers due to the need for more seating capacity.

Thus, a large number of forty-foot vehicles was generated by these new constraints. Because of the overwhelming fleet size of these two transit agencies relative to most of the others in the surveyed communities, the trends may appear to be a long-term shift toward forty-foot vehicles, but in reality, the trend is a shift toward larger vehicles, as one of them is shifting from thirty-foot vehicles to forty-foot vehicles and the other one is only temporarily shifting toward forty-foot vehicles. As mentioned above, it is demonstrating sixty-five foot vehicles and will even be looking at the possibility of adding eighty footers in the future.

Another way of looking at this is the breakdown of the communities. As Figure 18 shows, 50% of the surveyed communities are only ordering sixty-foot articulated vehicles for their "BRT-heavy" corridors, while almost all of the communities are ordering sixty-footers in general (94%). Half (50%) are ordering forty-footers and only 20% are ordering 30-footers. The trend for "BRT-heavy" corridors is clearly toward larger buses, with the predominance being articulated vehicles.

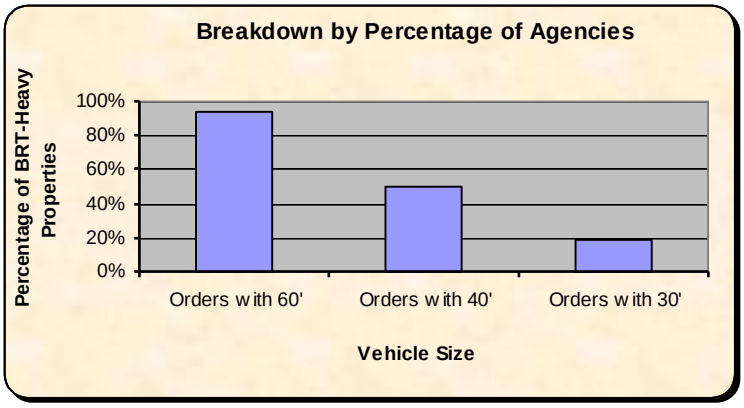

Figure 18: Percentage of orders per surveyed community

5.4.2 "BRT-heavy" Communities: Articulated Vehicle Deliveries, by Length

Figure 19 illustrates the projected procurements of articulated vehicles by "BRT-heavy" transit properties in terms of annual deliveries versus cumulative deliveries. One can see a fluctuation in the data for 2010 due to the lack of delivery numbers from the larger transit fleets. It's also important to note that 2012 approximates the limits of clarity for the communities' planning (which is about 5 years), so the numbers drop off at that point.

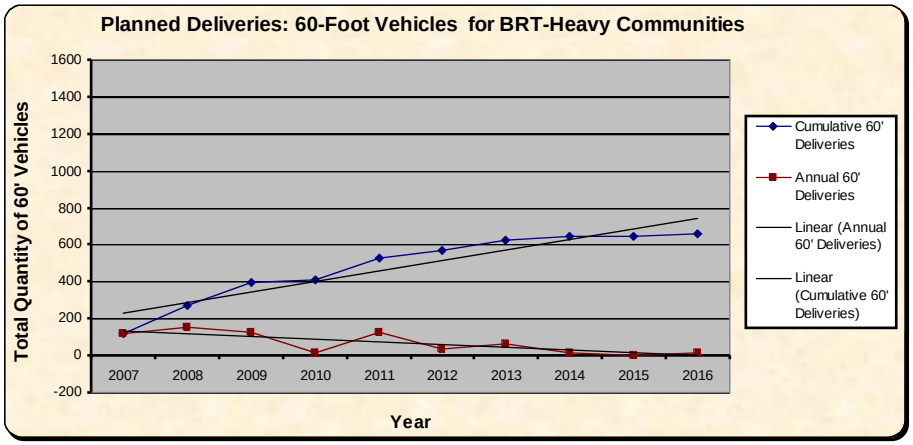

Figure 19: Articulated vehicle deliveries – cumulative versus annual numbers

In Figure 19, the annual deliveries of articulated vehicles for these "BRT-heavy" communities fluctuate around 100 per year with a top range of 150 in 2008. Over the ten years, it is expected that over 600 articulated vehicles will be ordered by these transit properties.

5.4.3 "BRT-heavy" Communities: Forty-Foot Vehicle Deliveries

In the projected procurements of forty-foot vehicles by "BRT-heavy" transit properties, the annual deliveries reach a zenith at 330 vehicles per year with a there is a strong increase across 2009 and 2010 due to an increase in orders from two agencies. There is a decrease around 2012 and onward due to the end of delivery runs and lack of planning clarity for large customers. This kind of decrease can be expected, as vehicle delivery prognostications usually grow murky four or five years past the survey date for a lack of federally required long-term plans.

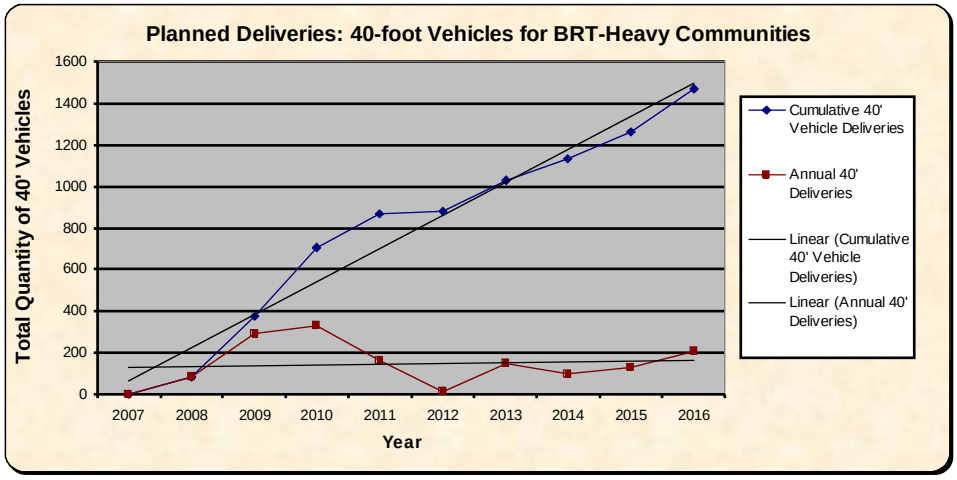

Figure 20: Cumulative versus annual 40' deliveries

5.4.4 "BRT-heavy" Communities: Vehicle Deliveries, by Fuel

The interviewees were also queried regarding their choices in fuels for their "BRT-heavy" systems. The vehicle deliveries for all sizes were aggregated for the "BRT-heavy" transit properties**,** by fuel. A high

percentage of these vehicles will be using biodiesel (65%) as the fuel of choice.[9] In Phase I, the percentage of BRT transit properties with biodiesel was 12%, so the difference between BRT overall and "BRT-heavy" here is great.

There were a few reasons for this. In the months between the studies for Phase I and Phase II, the engine manufacturers certified B20, which allowed more properties to begin testing and planning with the secure knowledge of the fuel being a good fit for the engines. There were several environmental reasons that were cited also for choosing biodiesel, including energy security/global warming, low emissions (especially when combined with an HEV system), and the pressure on the properties from constituent groups to go "green".

Of the vehicle deliveries, 25% were going to be utilizing Compressed Natural Gas vehicles, and only 5% were going to be using ultra low sulfur diesel.[10] It appears that the "BRT-heavy" communities are not just cutting edge with vehicle technology and marketing, but with fuel also.

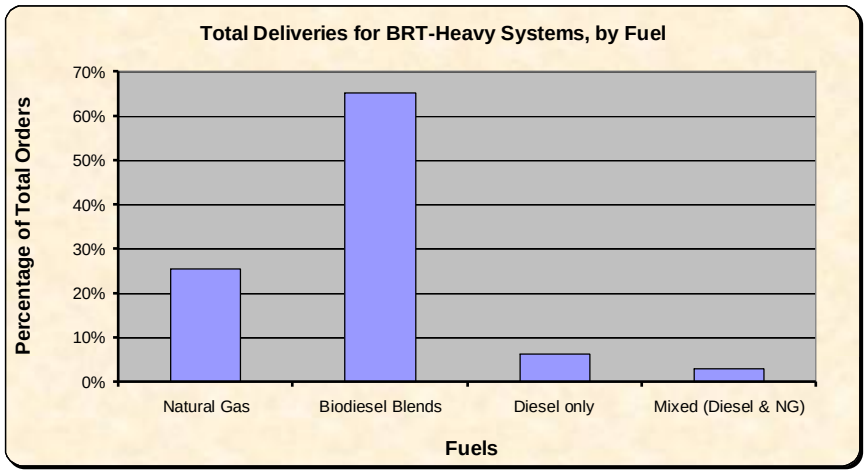

Figure 21: Deliveries, by fuel

5.4.5 "BRT-heavy" Communities: Vehicle Deliveries, by Propulsion

The interviewees were asked about their planned vehicle propulsion systems. The number of hybrid-electric vehicles (HEVs) was slightly greater than the number of vehicles with internal combustion engines (ICEs) in terms of overall vehicle delivery numbers 1,262 to 1,082 or 54% to 46%, respectively. Interestingly enough, twelve transit properties chose HEVs while only five chose ICEs. In fact, of the five who chose ICEs, four were using compressed natural gas (CNG) as the fuel of choice while the other chose biodiesel. It appears that the dominant choice among "BRT-heavy" properties is the HEV.

[9] Due to the high rates of success among respondents who had already tested their fleet on biodiesel, this report assumes that those "BRT-heavy" communities that were trying out biodiesel were going to eventually choose the fuel.

[10] ULSD has been mandated to replace regular diesel by the EPA as of October, 2006 ("Fuels and Fuel Additives, EPA web site: http://www.epa.gov/otaq/regs/fuels/diesel/diesel.htm).

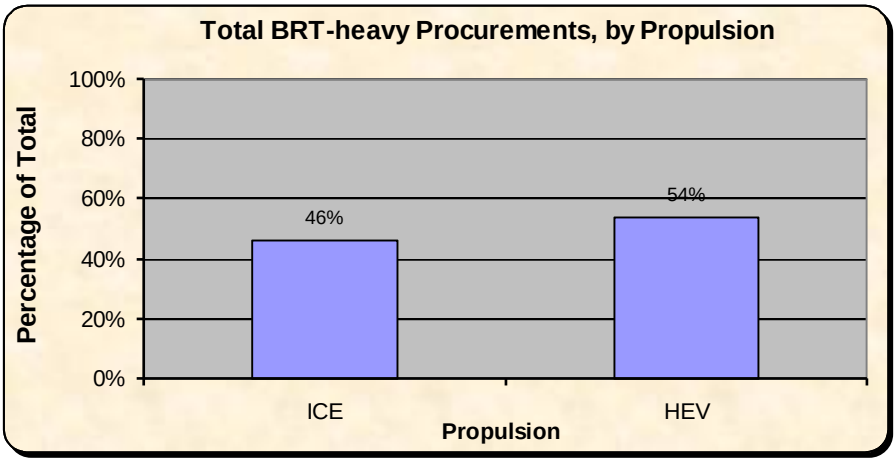

Figure 22: "BRT-heavy" deliveries by propulsion

5.4.6 "BRT-heavy" Communities: Vehicle Aesthetics

Because much of the BRT industry is focused on comfort and style in addition to performance, the interviewees were queried about their views on BRT vehicle aesthetics. In the five years since the 2002 BRT Vehicle Demand Analysis, there have been dramatic changes in bus vehicle styles. Fifty-three percent of Phase II interviewees were satisfied with the improvements in recent BRT styling upgrades but there was a significant percentage (24%) that was still pushing hard for more development. Seventy-seven percent described the look they wanted as that of a bullet train, or a "modern", "aerospace", or "rail-like" design, and frequently cited the Civis and Wrightbus as examples of the aesthetic they desired, if not the performance.[11]

Surprisingly, a high percentage (40%) of the respondents was interested in the design of the vehicles' tail area and would like to see some kind of design options (i.e.: large windows in the back). Many of these respondents found it difficult to interest the bus manufacturers in discussions regarding the vehicles' tails. It must be noted that in a few cases, windows have actually been placed in the tails of buses, but with the existing engine accompanied by the growth in the size of the emissions control equipment, manufacturers are faced with an increased challenge to meet the spatial needs even in new tail designs and might be hard-pressed to make further alterations.

5.5 "BRT-heavy" Communities: Guidance

The communities were also quizzed about their desire to have vehicle guidance capability for narrow-lane rights-of-way and for docking at stops and stations. The Regional Transportation Commission of Southern Nevada had attempted to implement an optical guidance system for its articulated vehicles in Las Vegas but had moved to a manual version after having uneven test results. A few other communities are actively seeking docking assist systems.

Only 24% of the surveyed "BRT-heavy" communities are planning for precision docking or vehicle guidance. 12% are undecided on precision docking, while 18% are undecided on vehicle guidance. As mentioned in Phase I, some of the communities stated that a lack of tried and tested proof is holding them back, so they're waiting to see what happens with the plans for guidance in Cleveland's Euclid Corridor project.

[11] While the Civis was popular for its looks, the narrow body and low speeds were not attractive to the interviewees.

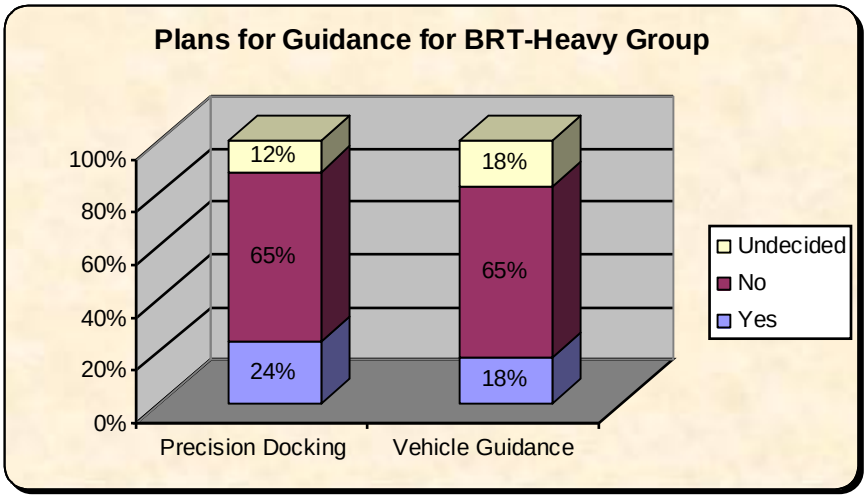

Figure 23: "BRT-heavy" guidance plans

5.6 "BRT-heavy" Communities: Migration of Elements

One of the rationales for choosing to study "BRT-heavy" systems as opposed to BRT communities in general was the idea that "BRT-heavy" communities serve as the model for future BRT systems and can predict future trends. Because so many of the elements of a BRT system are not bundled and can thus migrate freely from "BRT-heavy" systems to "BRT-lite" or non-BRT systems, we expect many of the elements to "migrate" to regular bus systems. The "BRT-heavy" planners were asked their thoughts on this "migration" pattern, and which elements they foresaw moving to systems that are "BRT-lite". The answer was simple: all of the characteristics will eventually migrate from BRT to non-BRT systems, except for dedicated right-of-ways, which are the defining portion of "BRT-heavy" systems. The list of responses includes the following, among others:

- Real time passenger information
- Longer vehicles
- Branding
- Increased frequency
- Simplified routes
- Shelter design
- Fewer stops
- More bus lanes
- Larger shelters
- TSP

5.7 Summary of Main Observations from Phase II:

As we saw in section 4.1, there is a gap between growth rates of "BRT-heavy" systems that occurs between 20008 and 2010. Because of the spurt of "BRT-heavy" systems that will appear in 2010 onward, we are led to the opinion that the slowed rate of growth in this three year period is part of a generational transition. The success of the early adopters has now paved the way for the next generation of "BRT-heavy" communities to plan their systems. As more "BRT-heavy" systems pass the litmus test and the lessons are transmitted to other properties, it is possible that the rate of "BRT-heavy" implementation could accelerate even further, especially if the federal government's investment in transit increases along with it.

- A strong and consistent rate of "BRT-heavy" implementation will begin in 2010.
- The balance of the "BRT-heavy" communities' orders that were surveyed have shifted somewhat between an equivalence of forty-footers and articulated vehicles to the smaller of the two lengths, which is due to the need for increased capacity. In the case of the shift from thirty-foot vehicles to forty-foot vehicles, it's due to a need for more passenger capacity than was previously forecast, while in the case of the sixty-foot vehicles, it's due to a need for greater vehicle storage capacity.
- There is strong growth in plans for biodiesel.
- Hybrids are overtaking internal combustion engines for "BRT-heavy" systems.
- American BRT vehicle design has improved significantly in recent years but still needs to catch up with the aesthetics of the European model designs.
- Significant demand exists for tail design but is not being met.
- Because of the migration of BRT elements into non-BRT systems, "BRT-lite" may become the de facto bus system in the future.

6.0 CONCLUSION

From this series of BRT Vehicle Demand Analyses that began in 2002, it has become clear in a short amount of time that BRT is successfully and rapidly sweeping across the United States. Many of the existing "BRT-heavy" properties that we interviewed have had so much ridership success that they are struggling to keep up with the demand and have had to order larger vehicles ahead of their projected schedules. Combined with the large investment in advanced technologies and alternative fuels by the transit properties, it is apparent that a higher level of "BRT-heavy" systems are emerging from the previous BRT generation's successes and are increasing quickly in their rate of implementation, trending more and more upward. When speaking with these communities, it appears that the main hurdle returns to the lack of funding security, but if the federal government were to invest more in BRT, it's possible that more of that demand could be met, and would possibly catalyze an even greater national demand.

Part of the branding success of BRT has led to the creation of more aerodynamic "space age" vehicles that look strikingly different from the buses of just a few years ago. Still, there remains a gap between what the transit planners would like to order and what they can afford, which may be slowing down the growth rate of the systems nationwide and their vehicle's aesthetic development.

Even with these funding gaps, the long-term success of BRT appears to be highly sustainable, as the implementation rates for BRT-lite and BRT-heavy systems appear to be moving at healthy rates. In fact, the elements that define BRT have been successfully migrating on an individual basis to traditional bus systems, meaning that eventually there might not be a difference between the traditional bus system and "BRT-lite".

Still, with all of this success, the largest remaining challenge appears to be the creation of a "full BRT" system, much like those in Curitiba and Bogotá, which function well above the normal role of a transit corridor to reshape the city. It would seem that the lack of readily available guidance technology is one of the last remaining hurdles to creating the technical elements of a system that can smoothly and holistically simulate the rail-like experience of the South American systems.

7.0 REFERENCES/BIBLIOGRAPHY

1. Arias, Stephan, etc…; "Bus Rapid Transit: Arriving on the World Scene"; *Sustainable Mobility: A publication of EMBARQ and the Center for Sustainable Transport in Mexico*; October, 2006.
2. Arrillaga, Bert; Bus Rapid Transit Vehicle Demand and Supply Analysis; CALSTART; September, 2002.
3. Arrillaga, Bert, Larry Wnuk, and Fred Silver; Bus Rapid Transit Vehicle Demand and Supply Analysis Update; CALSTART; June, 2004.
4. Cain, Darido, Baltes, Rodriguez, and Barrios; *Applicability of Bogotá's TransMilenio BRT System to the United States*; National Bus Rapid Transit Institute (NBRTI), Center for Urban Transportation Research (CUTR); May, 2006.
5. Diaz, Chang, Darido, Kim, Schneck, and Booz Allen Hamilton; Characteristics of Bus Rapid Transit for Decision-Making; Booz Allen Hamilton, Inc.; August, 2004.
6. FTA Web site:

Note: most of the data for this publication were gathered via original research via survey and electronic interviews.

8.0 APPENDIX: LIST OF SURVEYED BRT COMMUNITIES

1	Birmingham	AL	27	St. Petersburg	FL	53	Austin	TX
2	Phoenix	AZ	28	Atlanta	GA	54	El Paso	TX
3	AC Transit	CA	29	Honolulu	HI	55	Ft. Worth	TX
4	Bakersfield	CA	30	Arlington Heights	IL	56	Houston	TX
5	Chula Vista	CA	31	Chicago	IL	57	San Antonio	TX
6	Fresno	CA	32	Indianapolis	IN	58	Provo	UT
7	Los Angeles	CA	33	Olathe	KS	59	Salt Lake City	UT
8	Monterey-Salinas	CA	34	Louisville	KY	60	King County	WA
9	Orange County	CA	35	Boston	MA	61	Seattle	WA
10	Riverside	CA	36	Montgomery County	MD	62	Snohomish County	WA
11	Sacramento	CA	37	Kansas City	MO	63	Vancouver	WA
12	San Bernardino	CA	38	Charlotte	NC			
13	San Diego	CA	39	Omaha	NE			
14	San Francisco	CA	40	Mercer County	NJ			
15	San Mateo	CA	41	Newark	NJ			
16	Santa Clara County	CA	42	Albuquerque	NM			
17	Santa Monica	CA	43	Las Vegas	NV			
18	Boulder	CO	44	Reno	NV			
19	Denver	CO	45	Albany	NY			
20	Fort Collins	CO	46	New York	NY			
21	Hartford	CT	47	Cleveland	OH			
22	Washington	DC	48	Oklahoma City	OK			
23	Hillsborough County	FL	49	Eugene	OR			
24	Jacksonville	FL	50	Portland	OR			
25	Miami	FL	51	Pittsburgh	PA			
26	Orlando	FL	52	Providence	RI			

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