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Bus Rapid Transit
Vehicle Demand Analysis Update

June 2004

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13. ABSTRACT (Maximum 200 words) **The report presents data from public documents and interviews with transit properties about their BRT plans for 2004 through 2013. The report compiles information about the quantities of vehicles, delivery timing and vehicle preferences such as vehicle type, dimensions, floor height, propulsion, image and appearance, as well as supporting technologies such as automated vehicle location (AVL), signal priority, cashless fares, and other infrastructure. An aggregate view is developed about the features in vehicles for BRT implied by the community transit plans now and in the near future. Some bus manufacturers offered suggestions for presentation and format of the data that may assist the industry in priority and investment discussions related to new technologies. 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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Office of Mobility Innovation, Service Innovation Division

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Foreword

This report represents one part of an effort to provide information to the U.S. transit authorities on activities related to Bus Rapid Transit (BRT).

Notice

Preface

This report was prepared by CALSTART, Inc., the California operating division of WestStart. The data contained in this report includes planning information that carries a degree of uncertainty. While it may reflect current thinking of transit properties relative to Bus Rapid Transit, the specific quantities or timing may not occur and the preferences identified now may change in the future.

Acknowledgements

The Federal Transit Administration (FTA), Office of Mobility Innovation, sponsored the report. CALSTART would like to acknowledge the contributions that made this report possible. The study was conducted through telephone interviews, face-to-face interviews and email questionnaires as well as review of public documents provided by participants, information from websites and other public sources and refined based on interview data. The authors would like to express their sincere appreciation to the many people that 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, various manufacturer or supplier 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

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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 BRT Vehicle Demand Analysis

The FTA intends to identify more effective ways to encourage the supply of U.S. made vehicles to the U.S. BRT Communities. At the request of industry stakeholders, an analysis characterizing the U.S. "demand" for vehicles suitable for use in BRT system settings was published in 2002. An expanded data set is now available to update that analysis. This analysis update intends to reflect the state of the U.S. market demand for vehicles by BRT communities based on their known or published plans for vehicles.

This work documents data captured from public documents, websites, and transit-industry sources as well as from direct interviews with the designated transit property or management planning organization planners about their plans for implementing BRT corridors. The results drawn from the compiled information describes the quantities of vehicles, delivery timing and vehicle preferences such as vehicle type, dimensions, floor style, propulsion, image and appearance, as well as supporting technologies such as automated vehicle location (AVL), signal priority, cashless fares, and other infrastructure. The results are based on aggregating and cumulating the community-provided data over the period from 2004 to 2013.

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 quantities of vehicles and preferences for features in those vehicles. On the manufacturing side, the data may assist in setting in-house priorities and even investment decisions regarding continued development of technologies that support the features in vehicles the transit properties feel are necessary for future BRT service. For public agencies and the transit industry side, this data provides a composite view of the U.S. BRT status and a glimpse into future.

In support of such a goal, bus manufacturers 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. Specifically, this data is not intended to provide information for near term marketing to the industry.

1.2 Organization of this Document

This report is organized into four succeeding sections. All the data and results are contained in the body of the report and there are no appendices. The information is portrayed in exhibits and tables and organized within sections by a two level depth of headings. The text accompanying the exhibits and tables describes both literally and suggests related nuances that expand on the background of the data.

Section 2 is an Executive Summary that provides a brief overview of the pertinent data and observations. In Subsection 2.1, the purpose and analysis approach is described along with the list of communities contacted for the analysis. In Subsection 2.2, the major findings in terms of vehicle quantities, delivery timing and vehicle preferences are highlighted in bullet lists rather than exhibits or tables. Following in Subsection 2.3 is a summary of the observations and implications of the data. Section 3 begins the body of the report with tables expanding upon the purpose of the data capture, more detail on the analysis applied and how the results are compiled and used to formulate results.

Section 4 contains the results in exhibits that plot data or in tables that provide insight into the various topics. Section 4 is divided into subsections with Subsections 4.1, 4.1, 4.3 and 4.4 containing an over-all picture of the quantities and timing of the various “types” of vehicles – 60-65’ articulated buses, 40-45’ conventional buses and 30-35’ conventional buses. Information is provided by community and by time-series for the projected vehicles.

Subsection 4.5 delves into the preferences for the features in articulated buses. Subsection 4.6 presents the feature preferences for 40-45’ buses. Then subsection 4.7 addresses the preferences in 30-35’ buses, which are used by only a few communities. The final subsection 4.8 provides a brief discussion on such items as frequency of transit signal priority use and preferences for other the related BRT components.

Section 5 provides some key observations regarding the data contained in the exhibits. Implications are drawn from these observations that are also discussed to complete the analysis.

2.0 Executive Summary and Major Findings

2.0 Executive Summary and Major Findings

This section highlights the purpose and approach to analysis then summarizes the principal findings regarding vehicle preferences from communities contacted. Although the focus of this report is the vehicles, for background the preferences of other BRT components are summarized. Finally, top-level implications drawn from the results complete this executive summary.

2.1 Analysis Purpose and Approach

The intent of this work is to update an analysis of vehicle preferences for BRT communities published in 2002. Twenty-eight (28) communities were contacted for that previous work and they were re-contacted for this analysis along with an additional twenty (20) communities for a total of forty-eight (48). The purpose is to reflect the current market demand preferences for BRT vehicle characteristics. The strength of a feature preference is measured by a ratio, as a percent, of vehicles planned to have that feature to total quantities delivered over a ten-year period, 2004 to 2013. The approach involved researching public documents and amplifying that information with interviews of planners at the communities.

2.1.1 Communities Contacted

Communities selected for the analysis were based on FTA guidance as was the original work. Information has been compiled from a majority of the forty-eight communities; however, some did not have their plans sufficiently developed to provide information on vehicle preferences for this analysis.

2.2 Major Findings

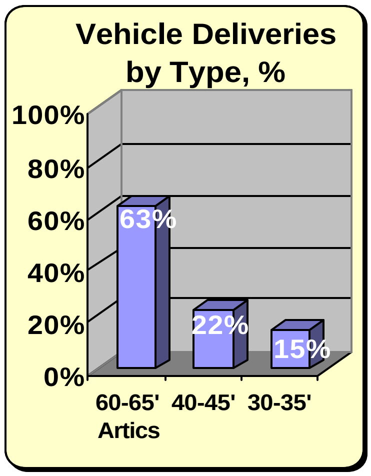
The major findings include these top-level results plus subsequent data and analysis under the vehicle type headings:

- The number of new communities implementing BRT service corridors is growing at a rate of 4 to 6 per year.

- The quantity of BRT vehicles for those communities implementing BRT service totals 5210 over ten years, 2004 to 2013.

- The split among BRT vehicle types is similar to the 2002 Analysis percentages at 63% articulated 60-65' bus, 22% 40-45' bus and 15% 30-35' bus as shown in Exhibit 1.

- The trend-line for annual 60-65' articulated bus deliveries for the BRT communities increases over the ten years, to over 350 units annually.



- The trend-line for annual 40-45' bus deliveries is even or slightly declines over the ten years.

- Funding and other issues lead to some uncertainty in quantities or timing so actual delivery quantities of vehicles may be less than planned.

Exhibit 1 BRT Vehicles by Type in Percentages

2.2.1 Articulated Vehicles

The majority preference in vehicles for BRT service in transit communities is higher capacity buses – the communities and planners perceiving such vehicles as more cost effective relative to the capacity increases needed. Articulated vehicles with a length of 60 to 65 feet are the leading choice in these high capacity buses. The following bullets relate to the vehicle features listed on the left axis in Exhibit 2. The degree of preference for the feature is expressed as the percent of the vehicles to be equipped with the listed feature out of the projected 3,262 articulated vehicles planned by the communities. The top axis is the percent scale.

- Low-floor, at the entry/exit doors, is the dominant choice. Fifty-eight percent of the artics are planned for delivery with full-low floor and 32% in a step-low floor configuration; both low at the entry door. Although not shown in Exhibit 2, only one percent (1%) of the vehicles are planned with standard (high) floor height and nine percent (9%) were undecided yet.

- Sleek, modern, rail-like appearance was preferred for seventy-three (73%) of the 60-65' articulated BRT vehicles.

- Fifty percent (50%) of the artics are planned with ICE propulsion.

- Twenty-four percent (24%) of the articulated vehicles are firmly planned as hybrids; but an additional twenty percent (20%) are considering taking delivery with hybrid powertrains for a combined total of forty-four percent (44%). An additional four percent (4%) are planning dual-mode propulsion and the remaining communities have not yet selected a drive train.

- Some of the 60-65' artic vehicles were preferred with 2 doors (twenty-two percent - 22%), 3 doors (forty-two percent - 42%) and six percent (6%) prefer 4 doors as shown in Exhibit 2. Although not shown, ninety-four percent (94%) preferred doors on one side with just six percent (6%) preferring doors on both sides

- Fifty-one percent (51%) preferred these vehicles with a reduced or lower-noise configuration, which is an increase from the 2002 analysis.

- Communities were seeking a total of thirty-six percent (36%) of vehicles equipped with docking guidance and, in some cases, also with lane assist.

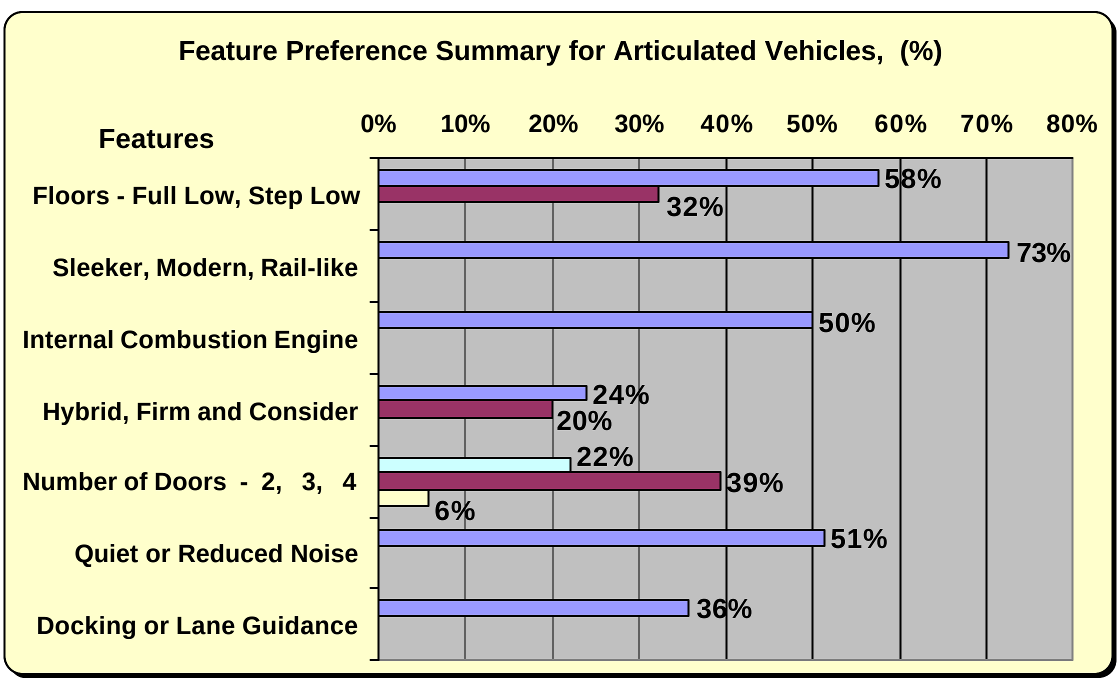


Exhibit 2 Articulated-Vehicle Features Preference Summary

2.2.2 40-45' Vehicles

The 40-45' non-articulated bus preferences vary in a number of important ways from the 60-65' articulated BRT vehicles – image, propulsion and the high-technology features. Exhibit 3 portrays the same vehicle features as shown in Exhibit 2 with the corresponding preference percentages for the planned 1,184 deliveries of the 40-45' buses.

- As with the artics, the ifloor height preference for these vehicles is also low at the entry/exit doors. Forty percent (40%) prefer full-low floor interior and 18% step-low floor; only one percent (1%) prefer standard (high) floor, not shown, and there was a large percentage undecided on floor height.

- Very few 40-45' buses, twelve percent (12%), were preferred with a sleeker, modern, rail-like image. This is a departure from the artics, instead seeking "distinctive image", which means distinctive livery rather than design, 6 to 1 for this length bus over the sleeker "advanced image" .

- Fifty-seven percent (57%) planned an ICE drive train but an additional thirty-eight percent (38%) are strongly considering hybrid-electric drive.

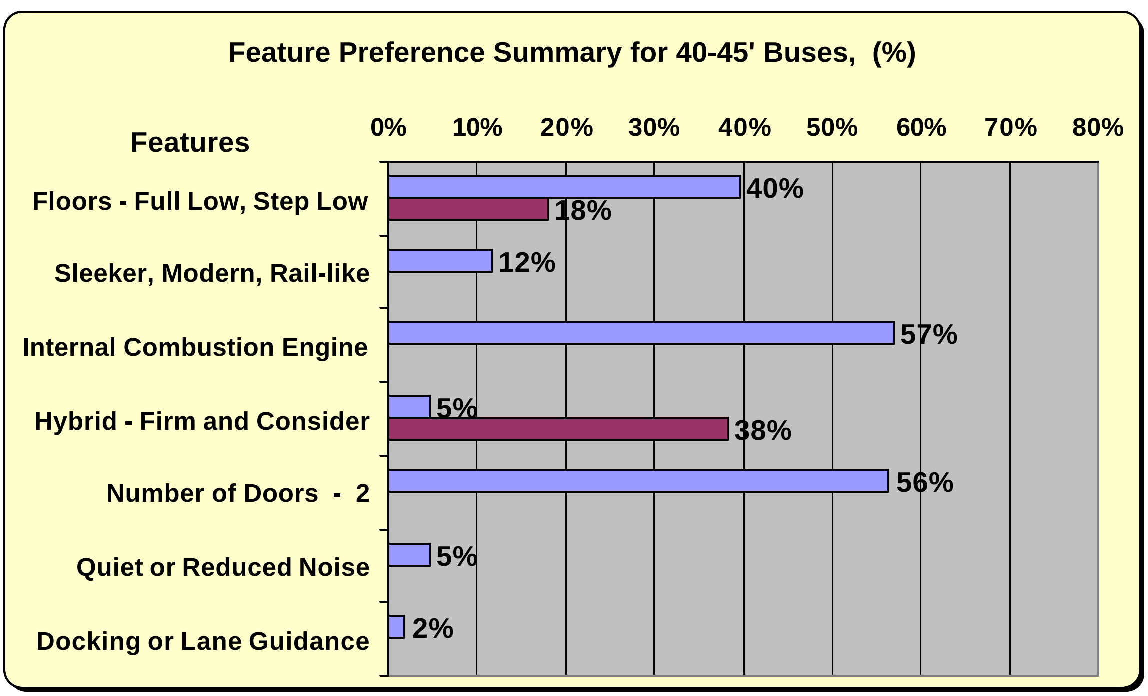


Exhibit 3 40-45' Vehicle Features Preference Summary

- Only five percent (5%) of the 40-45' vehicles are planned with hybrid-electric drive but if the 38% select hybrid drive the combined potential vehicles with hybrid-electric drive would total forty-three percent (43%).

- All door selections were for a single side with fifty-six percent (56%) selecting two doors but a large group expressing no preference yet.

- Interest in guidance is at 2% and low or reduced noise at 5 %.

2.2.3 30-35' Vehicles

The 30-35' conventional (non-articulated) BRT buses represent the smallest group by percentage (15%) of the BRT vehicles in this analysis, amounting to 784 buses. Despite the smaller size of these vehicles, the communities planning their use value image and identity, expressing preferences in some vehicle features similar to the preferences selected for the BRT artics. Exhibit 4 and the following discussion summarize these results.

- The dominant choice again in floor height is low at the entry/exit doors with only five percent (5%) selecting full-low and ninety percent (90%) going with step-low floors. Five percent (5%) offered no selection yet (not shown).

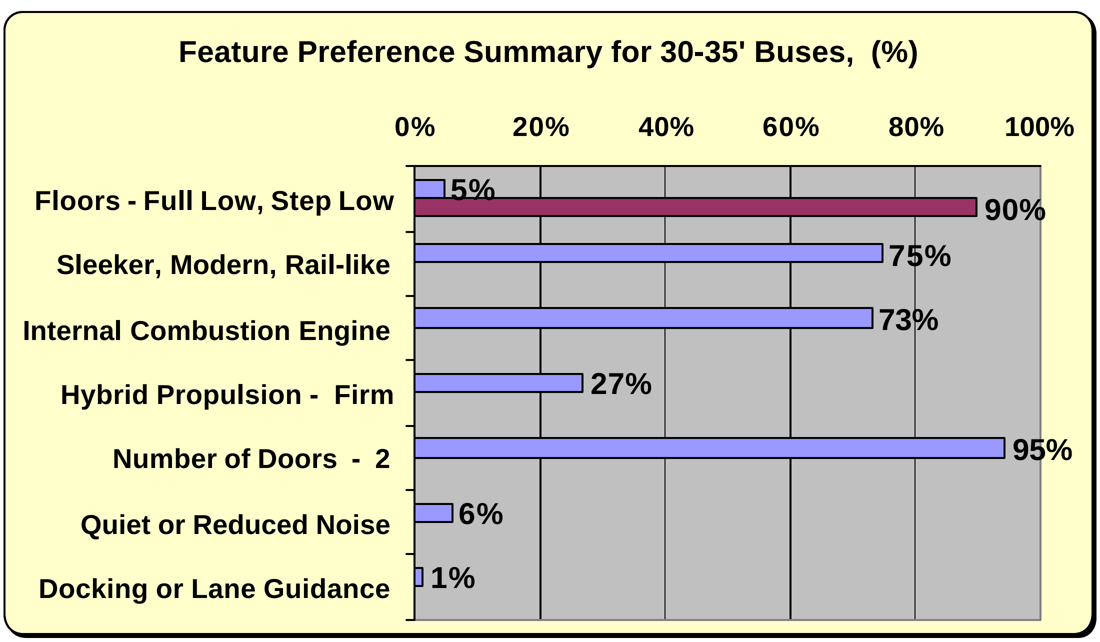


Exhibit 4 30-35' Vehicle Features Preference Summary

- "Advanced image" bus, meaning sleeker more appealing lines, was selected for seventy-five percent (75%) of this type of bus for BRT service.
- Seventy-three percent (73%) are planned with a ICE drive train.
- Twenty-seven percent (27%) would prefer these vehicles with hybrid drive.
- Doors again are one side and ninety-five percent (95%) plan 2 doors, 5% have no preference yet.
- Interest in guidance at 1% and reduced noise at 6 % is less important.

2.3 Summary Observations and Comments on Analysis Results

Section 5 draws on the analysis results to provide additional observations and comments. Also, based on detailed discussions with the bus-manufacturing sector, APTA and the FTA, the data is evaluated critically to reveal some possible implications of this growing number of service BRT implementations. The following highlights the observations and comments.

- A key similarity between the 2002 published analysis and this 2004 update is that the quantity of vehicles by type, as percent of the total planned vehicles, has remained consistent. This percentage breakdown, 63% 60-65' artic, 25% 40-45' buses and 15% 30-35' buses, respectively is still substantially different from the APTA five-year projections for new vehicle orders at 7%, 67% and 22%, respectively, for the U.S. transit industry emphasizing the interest in high capacity vehicles for BRT service.
- Comparing a key feature preference in the artics, there is a slight drop (79% to 73%) in the quantities of articulated vehicles preferred with the sleek, modern, rail-like appearance but increased interest in hybrid drive-trains, (32% compared to 27% firm plus 24% strongly consider a hybrid drive) instead of an ICE.
- The artic fuel choice preference remained about the same for compressed natural gas (CNG) but the planned used of ULSD as fuel almost doubled accompanied by a large drop for conventional diesel. Noise control interest grew a few percentage points and interest in docking guidance remained constant.

- The average (mean) annual delivery quantity (per BRT Community) is 28 vehicles per year, the median is 18 and the mode is 14 with only two (2) communities expecting annual delivery quantities near one hundred (100).

- Accompanying the consideration of hybrid propulsion for artics is also an interest in CNG. First, for vehicles firmly planned as hybrid, ULSD was the hands down choice. Of the vehicles <u>considered</u> for hybrid drive trains, CNG was the preferred fuel by 3 to 1 over ULSD. For ICE powered vehicles, 32% to 19% preferred CNG over ULSD. This results in almost equal numbers being planned for ULSD and CNG over the next ten years.

- An issue raised by the manufacturing sector is classification of the vehicles. The concern is whether the vehicles planned for delivery are either "replacement" vehicles or "expansion" vehicles. This is difficult to ascertain directly. A community-by-community comparison to APTA data suggests that not all the planned vehicles in this analysis have found their way into the surveys returned to APTA. However, as the procurement process evolves, the line between expansion vehicles and replacement vehicles blurs and budget constraints tend to move the purchased quantities to future years.

- The BRT vehicle market is projected in excess of fifty-two hundred (5,200) vehicles over 10 years, which equates to a net capital investment in excess of $3 billion. The annual amount, at almost $300 million, represents only fifteen to seventeen percent (15-17 %) of the 2003 transit industry wide figures for the same length vehicles but a twenty-five to thirty percent (25-30%) of the annual capital investment. This is due to preference in planning delivery of vehicles with additional styling features and amenities to high-technology like hybrid-electric drive and docking guidance

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3.0 Analysis Plan

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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 implementations 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, 2004 to 2013. This task accumulates the available information by identified BRT corridors for the topics shown in the Table 1 below.

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

- **Quantities of vehicles – by corridor for each community**
- **Vehicle delivery timing – by corridor**
- **Vehicle characteristics – by corridor**
  - **type, dimensions, doors and interior design, propulsion and fuel, image and exterior requirements**
- **Supporting technologies and infrastructure – by corridor**
  - **vehicle guidance, vehicle location (AVL), signal interface, information display, fare collection, lane/right-of-way and design features, station requirements**

The results are a bottom up industry-based projection using the sources as identified in Table 2. For the most part, this data is based on available, published information and refined through personal interviews. Personal interviews of planners guide the selection of the most pertinent documents, assist in researching key information and provide a perspective for helping build the strength of a generic business case. The intent is to measure key characteristics about the BRT vehicle market 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 a community has reached for their 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 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. But plans change, no matter how firm they appear at the time, so the individual data by community is 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**
- **Funded Studies of Alternatives (Reports, Briefings)**
- **FTA Documents - BRT Project Concept Papers**
- **Major Investment Studies (MIS) and Scoping Studies**
- **Draft and Final Environmental Impact Statements (EIS)**
- **Documents Describing Locally Preferred Alternatives**
- **Workshop Papers, Websites, Newsletters, Public Reports**
- **Personal interviews with Transportation**

3.2 Demand Analysis Objectives

The objective of capturing this data is to provide a perspective on the quantities and preferences in vehicles that the 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. Near term these quantities and the delivery dates may result from the communities being in a proposal or contract stage and far term 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.

The preferences are 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 is 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. Specific data objectives for the formulation and presentation of this data include such items as propulsion, fuels selection, doors, floors, and appearance by vehicle type are listed in Table 3. Other pertinent preferences suggested by the communities are detailed such as interest in lane-assist or docking guidance and other ITS technologies as well as reduced noise and emissions. Bus Rapid Transit 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 2004 to 2013, by type – based on transit property planning**
- **Cumulate potential vehicle deliveries by type (2004-2013)**
- **Quantify demand for specific vehicle characteristics (propulsion, fuel, doors, floors and appearance), by vehicle type – as a percentage**
- **Identify and quantify, by corridors, specific BRT support technologies and infrastructure**
- **Make observations and derive implications from the results**

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4.0 Analysis Results

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4.0 Analysis Results

This section describes the results of background research, interviews with transit properties and subsequent spreadsheet analysis of the data collected. The first subsection identifies the communities and transit properties that the FTA suggests are planning BRT service along one or more corridors. Next, an overview of the types and quantities of vehicles these communities plan for delivery as well as a discussion about the state of their plans and opening dates for these service corridors. The next sections present feature preferences expressed for the articulated 60-65' buses, conventional 40-45' buses and conventional 30-35' buses planned for use in BRT implementations. The final subsection compiles information about BRT infrastructure and supporting components.

4.1 Communities and Transit Properties Contacted

Communities selected for the analysis, based on FTA guidance, are listed in the Table 4 below. Information has been compiled by contacting the twenty-eight (28) original communities for the 2002 analysis and an additional twenty (20) communities for a total of forty-eight (48) for this update. Some communities, indicated by an asterisk, are not far enough along in their planning to provide information at this time.

Table 4 – FTA Suggested Transit Communities for Analysis

Original Communities Re-Interviewed				
AC Transit	**Cleveland**	**Honolulu**	**New York**	**San Diego**
Albany	**Denver**	**Las Vegas**	**Dulles Corridor**	**San Juan ***
Atlanta	**El Paso**	**Louisville**	**Orange County**	**Santa Clara**
Boston	**Eugene**	**Los Angeles**	**Orlando-Lymmo**	**Seattle**
Charlotte	**Fort Collins**	**Miami**	**Phoenix**	*** No detailed data available**
Chicago	**Hartford**	**Montgomery Cty**	**Pittsburgh**	
Additional Communities Interviewed for this Analysis				
Austin	**Kansas City**	**Newark**	**Philadelphia***	**San Francisco**
Detroit	**Malvern***	**Olathe***	**Reno**	**Santa Cruz**
Houston*	**Milwaukee**	**Omaha***	**Salt Lake City**	**Snohomish Cty**
Indianapolis	**Minneapolis**	**Orlando-FlexBRT**	**San Antonio**	**State College**

4.2 Vehicle Quantities by Community

The Transit Properties pursued for responses for the study are identified alphabetically in Table 5. The potential total vehicle quantities identified for each respondent are shown in the columns on the right. The quantities represent the sum over the years 2004-2013 of potential deliveries by vehicle type for all corridors discussed with the responding community contacts. For some of the listed "communities," more than one transit property may be planning BRT corridors in the "region" of that community. The vehicle types are defined simply as 60-65' articulated vehicles (artics), and non-articulated vehicles with lengths of either 40-45' or 30-35'. Some information was unavailable at the time of this draft for some of the communities contacted leaving blank cells in Table 5. The timing of these quantities of vehicles will be provided in later charts and graphs.

Table 5 - Communities, Contact(s) and Vehicle Totals from the Analysis

Community	Transit Property or Planning Organization	Potential Vehicle Quantities		
		Artics	40-45'	30-35'
AC Transit	**Alameda-Contra Costa Transit District (AC Transit)**	**60**	**3**	
Albany	**Capital District Transportation Authority (CDTA)**		**20**	
Atlanta	**Metropolitan Atlanta Rapid Transit Authority (MARTA)**	**32**	**12**	**165**
Austin	**Capital Metropolitan Transportation Authority**	**25**		
Boston	**Massachusetts Bay Transportation Authority (MBTA)**	**146**	**100**	
Charlotte	**Charlotte Area Transit System (CATS)**	**16**		
Chicago	**Chicago Transit Authority (CTA) and Chicago Dept of Transportation (CDT)**	**80**	**355**	
Cleveland	**Greater Cleveland Regional Transportation Authority (GCRTA)**	**81**		
Denver	**Denver Regional Transit District (RTD), U.S. 36 Transportation Management Org**		**25**	
Detroit	**Metropolitan Affairs Coalition**	**27**		
El Paso	**Sun Metro**	**10**		
Eugene	**Lane Transit District (LTD)**	**15**		
Fort Collins	**Transfort Dial-a-Ride, City of Fort Collins**	**22**		
Hartford	**Connecticut Department of Transportation**	**44**	**10**	**10**

Community	Transit Property or Planning Organization	Potential Vehicle Quantities		
		Artics	40-45’	30-35’
Honolulu	**Department of Transportation Service, City and County of Honolulu**	**25**		
Houston*	**Metropolitan Transit Authority of Harris County**			
Indianapolis	**Indianapolis Public Transportation Corporation**	**40**		
Kansas City	**Kansas City Area Transit Authority (KCATA)**		**12**	
Las Vegas	**Regional Transportation Commission of Southern Nevada (RTC)**	**40**		
Los Angeles	**Los Angeles County Metropolitan Transportation Authority (LACMTA)**	**901**	**243**	
Louisville	**Louisville Transit Authority River City (TARC)**	**44**		
Malvern*				
Miami	**Miami-Dade County Transit Agency**	**15**	**10**	**600**
Milwaukee	**Milwaukee County Transit System**	**30**		
Minneapolis	**Minneapolis Metro Transit**	**14**	**12**	
Montgomery County	**Public Works and Transportation, Division Transit Services, "Ride On"**	**197**	**310**	**33**
New York	**MTA Long Island Bus**	**650**		
Newark	**New Jersey Transit**	**18**		
Northern Virginia	**Virginia Department of Rail and Public Transportation**	**7**		
Olathe*	**Johnson County Transit**			
Omaha*	**Omaha Metro Area Transit**			
Orange County	**Orange County Transportation Authority (OCTA)**		**38**	
Orlando	**Central Florida Regional Transportation Authority**			
Orlando-FlexBRT	**Florida Department of Transportation**			**36**
Philadelphia*	**Delaware Valley Regional Planning Commission (DVRPC)**			
Phoenix	**City of Phoenix**	**15**		
Pittsburgh	**Port Authority of Allegany County Planning Department**	**25**		

Community	Transit Property or Planning Organization	Potential Vehicle Quantities		
		Artics	40-45'	30-35'
Reno	Reno Regional Transportation Commission	15	7	
Salt Lake City	Utah Transit Authority	40		
San Antonio	San Antonio VIA Metropolitan Transit			
San Diego	San Diego Metropolitan Transit Development Board (MTDB)	60		
San Francisco	San Francisco Municipal Railway (Muni)	66	17	
San Juan	Puerto Rico Highway and Transportation Authority (Metro Bus Authority)			
Santa Clara	Santa Clara Valley Transportation Authority (VTA)	120		
Santa Cruz	City of Santa Cruz Transportation Commission		30	
Seattle	King County Metro Transit and Seattle County Sound Regional Transit	357		
Snohomish Cty	Washington Public Transportation Benefit Area Corporation (Community Transit)	20		
State College	Centre Area Tr ansportation Authority (CATA)			
*No information available for the community in this report				

4.3 Revenue Service Dates by Community

As more and more communities plan BRT service, an indication of this growth in BRT service implementations is the total number of communities added each year as shown in Exhibit 5. The data shown in Exhibit 5 shows the total number of communities that have opened at least one route or corridor over the years from 2004 to 2013. Each year more communities are added as shown by the scale on the left side of Exhibit 5. The data from this analysis suggests that from four to six communities are expected to be added each year until about 2010. A similar curve shows data taken from the 2002 Analysis. Note that the peak value for the 2004 analysis is forty-two (42) since data is available from 42 of the 48 communities in this analysis. Likewise, there is a peak value of 22 communities for the 2002 analysis for the same reason.

Also, the data in Exhibit 5 does not reflect subsequent routes or corridors that a community may open. AC Transit, for example, is contemplating at least 4

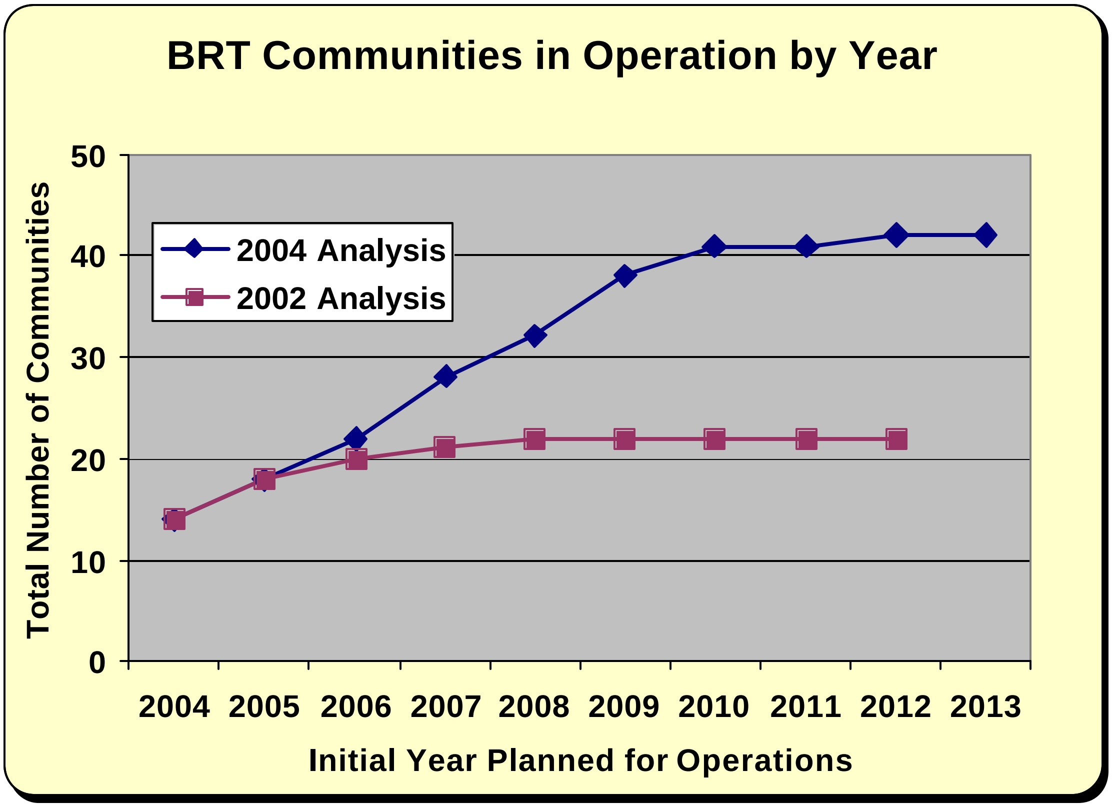


Exhibit 5 BRT Communities in Operation by Year

additional routes with possible in-service revenue dates and vehicle delivery quantities as shown in Exhibit 6. Exhibit 6 is a sample of the vehicle delivery data that is captured for all the communities in this analysis (except where plans were not sufficiently progressed). The total number of such corridors is one hundred thirty-five (135) for all the reporting communities.

AC Transit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Transbay Fleet - Artic	10									
Fuel Cell Bus Demo, 40'		3								
82 International Blvd, Artic			25							
MacCarther, Artic					12					
52 College, Partial Rapid, Artic							15			

Exhibit 6 Corridor Opening Date and Vehicle Requirement Projections - AC Transit

4.4 Potential Vehicle Deliveries

The quantities of vehicles planned for possible delivery by type are shown in Exhibit 7 as a percentage of the total vehicles reported which is five thousand two hundred ten (5,210). Artics amount to three thousand sixty-two (3,262) or sixty-three percent (63%) of that total. Twenty-two percent (22%) which amounts to eleven hundred eighty-four (1,184) vehicles are planned as 40-45' non-articulated buses meaning that at least eighty-five percent (85%) the vehicles the communities are planning for their service are high capacity vehicles.

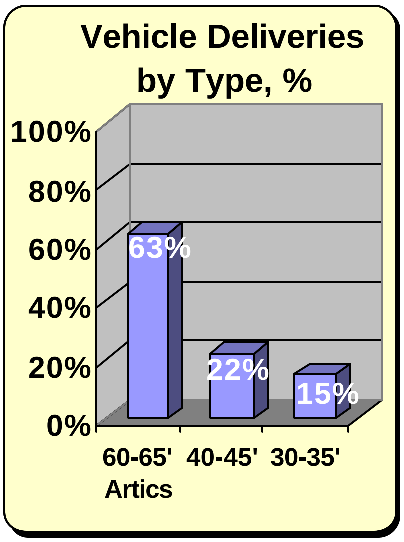


Exhibit 7 Total Planned Deliveries by Type

Only five communities are planning 30 to 35' buses, which amounts to seven hundred eighty-four (784) or fifteen percent (15%) of the BRT vehicles. One of those communities is seeking to add 100's of 30' vehicles over a number of years for a BRT service that involves sharing an exclusive right-of-way with other routes as well as local circulation for patron pickup prior to entering the exclusive ROW.

Since high-capacity vehicles are the bulk (85%) of the BRT vehicles, the annual deliveries are shown in Exhibit 8. The two types shown are articulated buses 60-

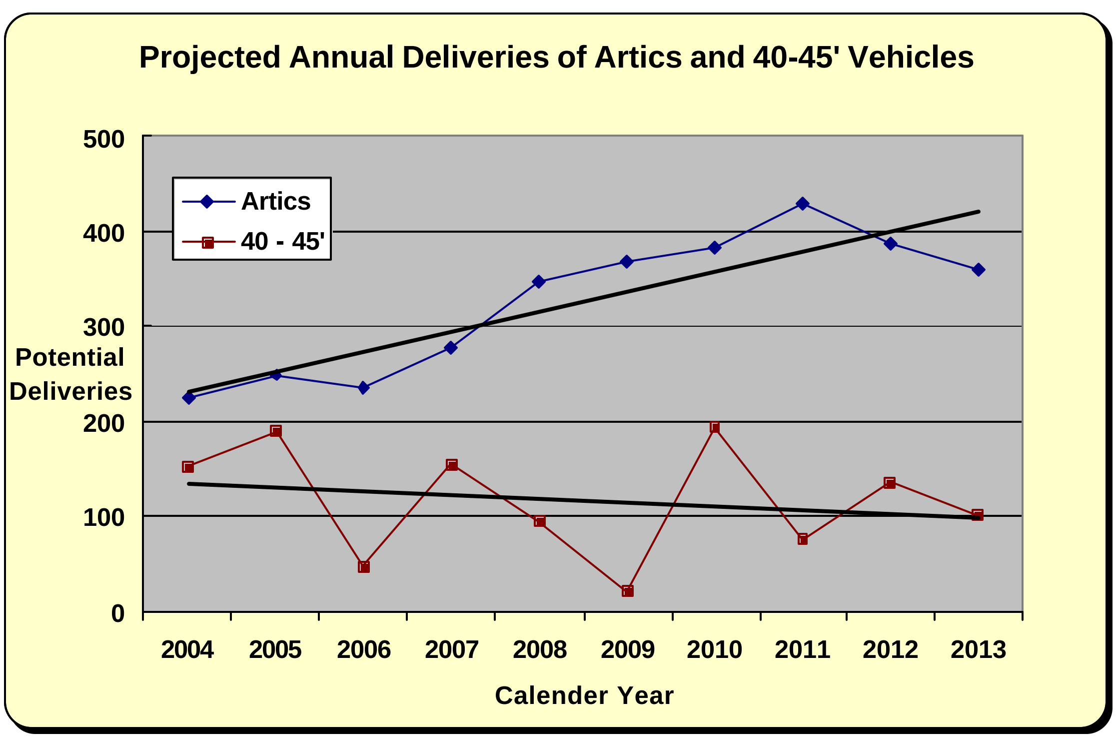


Exhibit 8 Projected Annual Deliveries of Artics and 40-45' Vehicles

65' and 40-45' buses over the 10 years. The 40-45, vehicle potential deliveries annually fluctuate but are less than 200 in any year. The artics are over 200 annually progressing to about 350 a year by 2010. The trendlines show the number of artics generally increasing while the 40-45' buses are holding steady or perhaps even declining slightly.

4.4.1 Observations about Delivery Quantities

The sources of the previous data on vehicle quantities and delivery dates are captured through interviews with planners that are involved with the typical public planning and the documents that the transit industry produces in support of this planning. In some cases, this information is planned many years in advance of the actual revenue service date for a BRT route leading to a degree of uncertainty in quantities and timing. The uncertainty arises from the budget process most importantly the availability of funds for the capital purchases. It would be useful to determine what stage a property is in relative to capturing the funds but this is difficult to determine. Instead, a measure of this uncertainty is the likelihood of the planned services opening on the date planned or receiving the quantities of vehicles planned expressed as a probability. For this analysis,

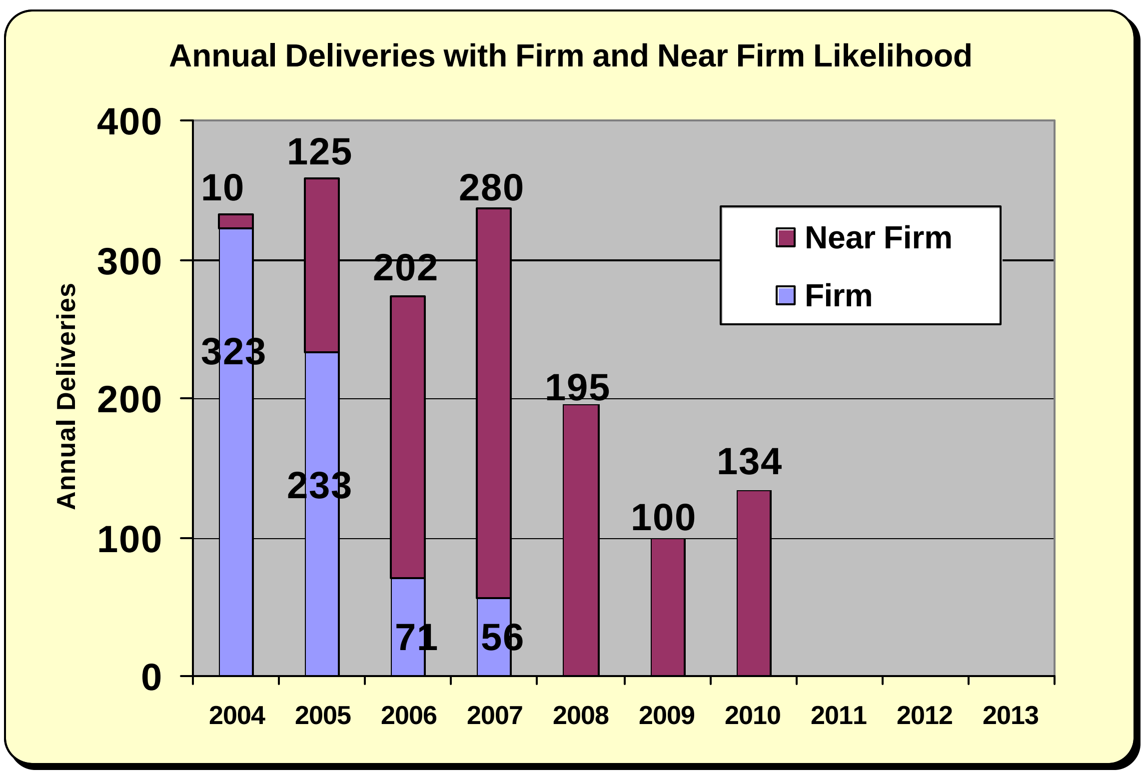


Exhibit 9 Annual Deliveries with Firm and Near Firm Likelihood

the quantities and timing are given a "firm" designation if the likelihood is estimated at greater than 80 percent. Typically, if the transit property is preparing a request for proposal or in some phase of the purchase process for vehicles, then the rating is estimated as firm. Interviewed planners were very helpful in providing this type of information. Likewise, if the likelihood was estimated by the planners as "near firm", then the quantity was in the range of 80 to 50% probability. Quantities and timing rated at 50% were designated as "planning" numbers. Exhibit 9 shows the annual quantities for all vehicles in terms of "firm" or "near firm" quantities. Note that looking ahead beyond 2-3 years the rating for the planned quantities and timing transition from firm to near firm. Exhibit 10 continues the process showing that beyond 5 years annual delivery designation is primarily a planning number. Putting the two exhibits together and adding the annual values year after year (cumulating) the numbers of vehicles by type results in previous Exhibit 7. The impact that this uncertainty has on the results is has been a concern expressed by the bus manufacturers. Bus manufacturers' experience suggests that the numbers of "planned" quantities eventually are reduced as the date to purchase the vehicles nears.

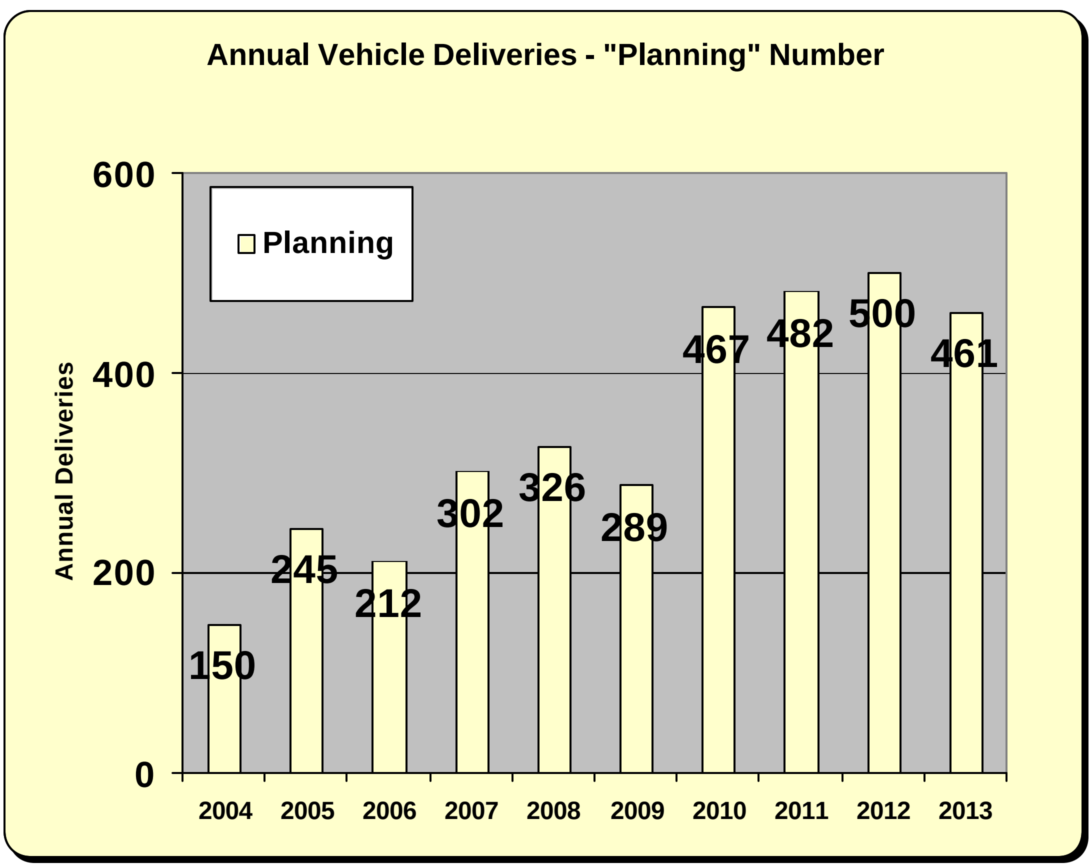


Exhibit 10 Planning Number (Likelihood) Annual Deliveries for All Vehicles

The analysis over the short term of the BRT evolution is that, while there is definitely such an effect at the individual community level, the growth trend in the number of BRT communities, as shown by comparing results from 2002 to 2004 analyses, may likely replace some of these lost vehicle opportunities with others. If the underlying need for added capacity and BRT service remains, then the effect translates into a change in timing not quantities which results in the total quantities over the time period still reflecting the status of the BRT market size.

4.5 Articulated Vehicle Preferences

The major preference in vehicles for BRT service in most communities is higher capacity buses – the communities and planners perceiving such vehicles as more cost effective relative to the capacity increases needed. Articulated vehicles are the leading choice in high-capacity buses as noted in the previous subsection. A stated preference for the artic vehicles is low-floors at the entry and exit doors. As shown in Exhibit 11 fifty-eight percent (58%) preferred full-low floor while thirty-two percent (32%) found step-low floors acceptable. Although nine percent (9%) did not feel their plans were sufficiently complete to express a floor preference only one percent (1%) suggested that standard (high) floor height would be preferred.

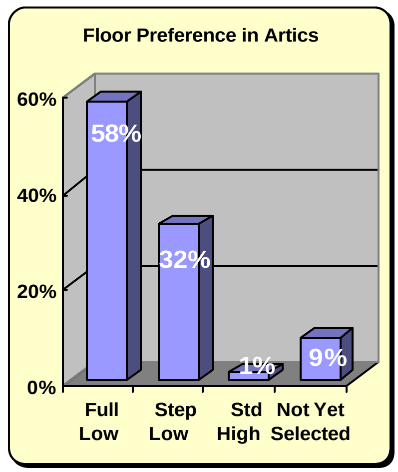


Exhibit 11 Artic Floor Preferences

In reviewing the results with both communities and bus makers, those representatives suggest that the no-preference group will most likely accept either full, continuous-low or step-low floors implying that for artics the preferences is ninety-nine percent (99%) low floor continuous or step-low floor. The following subsections identify the preferences culled from reports, data and interviews with transit communities on propulsion, fuel, emissions, doors, vehicle appearance plus technologies that can provide a guidance capability or reduce noise and increase comfort for the rider.

4.5.1 Articulated Bus Propulsion, Fuel and Emissions

Propulsion system preferences considered by the BRT communities for articulated vehicles showed an increasing sensitivity to emissions control and noise reduction. This is reflected in the growing interest in hybrid propulsion systems. Some planners definitely selected hybrids or internal combustion engines as part of the drive trains. Twenty-four percent (24%) of the articulated vehicles are planned as hybrids while another fifty percent (50%) are planned for powering by internal combustion engines (ICEs), as shown in Exhibit 12. At least an additional twenty percent (20%) could go either way – hybrid or ICE which is labeled "consider hybrid" in Exhibit 12. If this 20% group actually order hybrids this would amount to 44% of these vehicles could be hybrid-electric buses. About 4 communities, six percent (6%) have selected dual mode propulsion that is provided by electric catenary or is capable of diesel-electric motoring.

Also instructive is the timing of the deliveries of hybrids. In Exhibits 13 and 14 the annual quantities of (total) hybrid vehicles are shown with the estimates of firm, near firm and planning. As expected the firm and near firm quantities fall off in three to five years. The planning numbers begin increasing so that the average of the sum (firm, near firm and planning) is over one hundred articulated buses per year. The scales on the two exhibits differ with a slight increasing trend across the ten years.

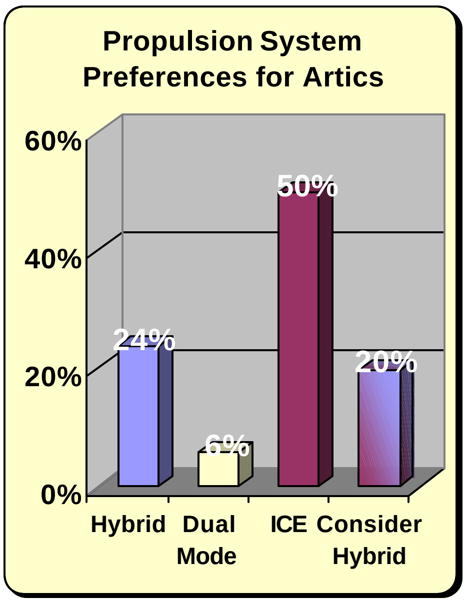
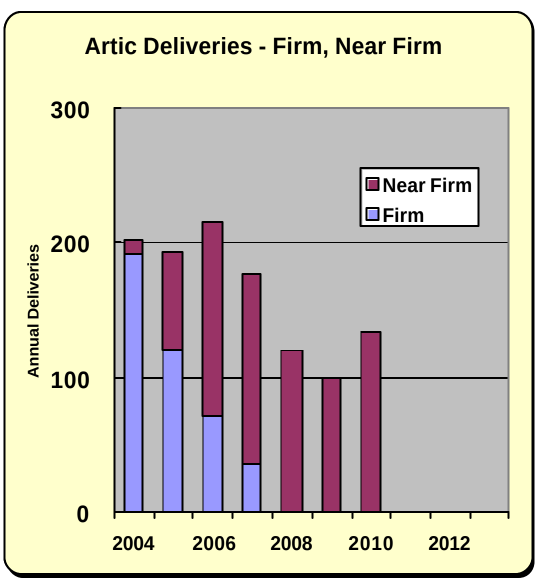


Exhibit 12 Propulsion Preferences for Articulated Vehicles



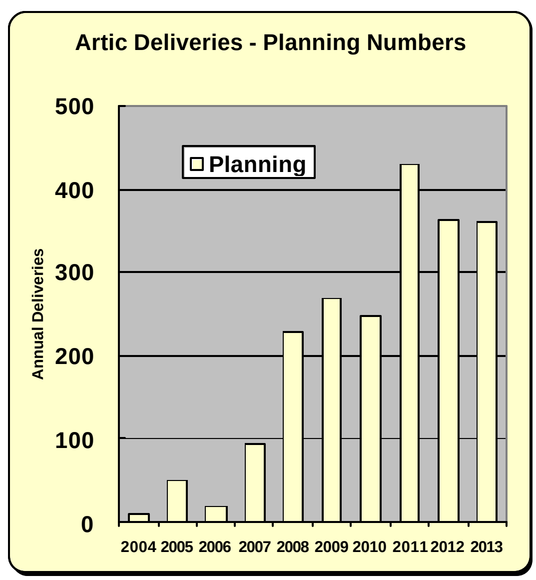


Exhibit 13 Artic Hybrids - Firm & Near Firm **Exhibit 14 Artic Hybrids - Planning Numbers**

The fuel preferences for articulated vehicles, without regard to the various propulsion systems, are reflected in Exhibit 15. Starting from the left most entry in Exhibit 15, conventional high-sulfur diesel amounted to a fuel choice for about 5% of the articulated vehicles planned by the communities (more on this latter). Surprisingly, only one of the communities had an active program to evaluate bio-diesel and virtually no community is willing to consider the fuel for BRT artics.

Most communities have access or are planning to have access to ultra-low sulfur diesel (ULSD) resulting in 39% of the artics planned for that fuel. Alternate fuel, compressed natural gas (CNG), continues to show strong support in the transit BRT community with 45% of the potential artics planned as alt fuel powered. Only a few (about 50) are considering liquefied natural gas (LNG) for an alternative fuel; which on the scale in Exhibit 15 shows as zero percent. A few BRT communities find that dual mode artics fit their plans for BRT which results in about 4% showing as powered by contact or catenary supplied electric power but with the capability to go off-catenary, typically being powered then by ULSD ICEs. Some communities felt their plans were in too early a stage to make a selection (7%) and some offered two choices. Those considering two fuels were counted as one-half a unit in the results in Exhibit 15.

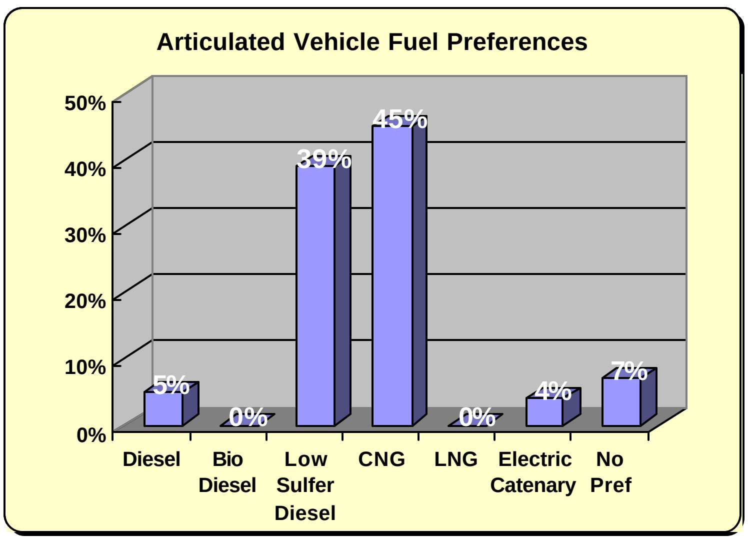


Exhibit 15 Fuel Preferences for Articulated Buses

The community preferences for the bulk of the 60-65' articulated buses are either hybrid drive systems or internal combustion engine power. The bulk of the fuel preferences are CNG, ULSD, or diesel. The combination of fuels and drive trains choices and preferences for articulated vehicles are shown in the Table6.

Table 6 Fuel & Propulsion Preferences for Artics

Drive System Choices	Fuel Choices		
	Diesel	CNG	ULSD
Hybrid-Electric	4%	1%	22%
Consider Hybrid	1%	16%	6%
ICE	0	32%	19%

Table 6 portrays the preferences for fuel in percent of vehicles with that fuel/drive system combination. The interesting thing to note is that those communities that would consider hybrids also would consider using CNG as a fuel. Whereas those transit properties, already selecting hybrids in their planning, are also selecting ULSD or diesel. This probably reflects what is currently the predominant hybrid drive train on the market today. Note that Table 6 is based on a smaller set of articulated vehicles than Exhibit 15, since it does not include the no preference or dual-mode categories drive train categories. Hence, the total percentages calculate slightly higher than in Exhibit 15.

A final comment about the fuels, Exhibit 16 shows articulated vehicle potential deliveries by fuel choice – CNG and ULSD in this analysis. The Exhibit 16 shows that deliveries of CNG-fueled vehicles overtake ULSD in the out years. This is the reason that CNG fuel rates a higher preference for the articulated vehicles as a whole. This reflects that LACMTA and Long Island (NYC) are planning annual quantities of 100 deliveries during that period along with some of the newer communities

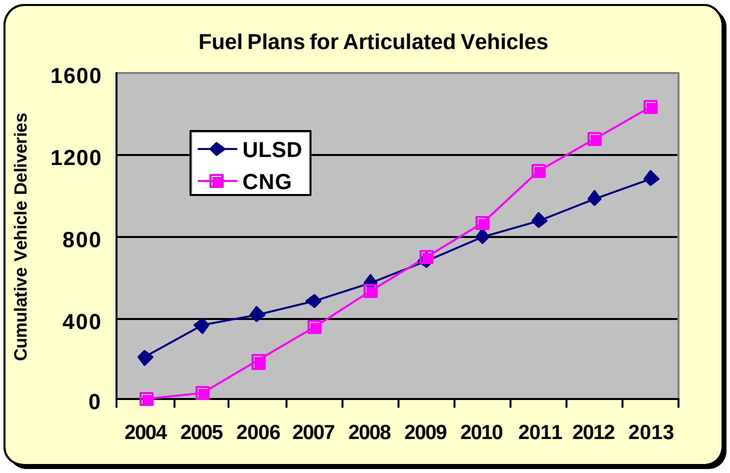


Exhibit 16 Total Vehicle Deliveries by Fuel

4.5.2 Articulated Bus Door Preferences

The door preferences for articulated vehicles are presented in two ways in Exhibit 17. Traditional door preference for single side openings represented the majority among the BRT communities (94%). About six percent (6%) of the communities have a need for both median and guideway side boarding locations. The percentage of vehicles planned for four, three or two doors are also shown in Exhibit 19. A large percentage, thirty-one percent (31%) were not far enough along

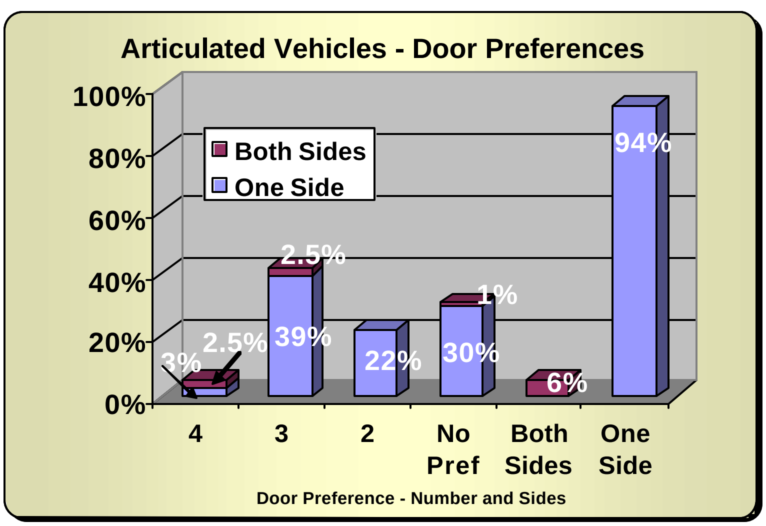


Exhibit 17 Articulated Vehicles - Door Preferences

in their vehicle planning to suggest a preference. Of those offering a preference, forty-one point five percent (41.5%) selected 3 doors with two point five percent (2.5%) of those preferring doors on both sides. Only about five point five percent (5.5%) wanted 4 doors, split between one and both side preferences.

4.5.3 Articulated Bus Appearance and Image

The BRT system concept is to implement a substantial improvement in bus service, with an image and identity separate from current bus operations, to maximize the potential for attracting additional riders. The identity here refers to branding of the vehicle and image relates to the style and aesthetics of the vehicle.

A color scheme and logo especially with distinctive, modern styling in the vehicles are elements that are growing more common among the communities. Often stations with highly visible identification elements are being used by transit authorities to differentiate the service. The communities were asked or information in their planning documents suggested the degree of identity and styling they planned for their vehicles. Some wanted distinctive identity and others wanted not only distinctive identity but modern, sleek, rail-like styling that we capture in the results in Exhibit 18 as “Advanced Image”. The communities preferred articulated BRT vehicles with “advanced image more than 3 to 1 over distinctive image alone. This is down somewhat from the 2002 Analysis perhaps reflecting the difficultly in purchasing these vehicles in the U.S.

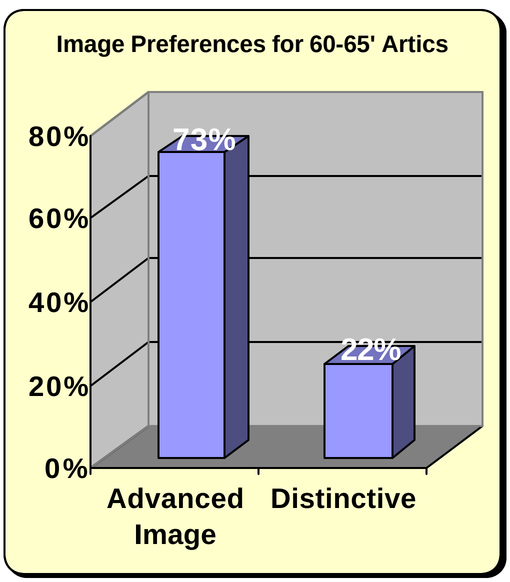


Exhibit 18 Articulated Bus Identity and Image

4.5.4 Articulated Bus Guidance and Docking Assist

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. Las Vegas is implementing an optical system for their artics and others are actively seeking a docking assist system.

The percentage of vehicles equipped with such a capability is of interest to the transit communities that were also interested in artics as shown by Exhibit 19. Over one-third, thirty-six percent (36%), of the potential artic deliveries were planned to be equipped with vehicle guidance.

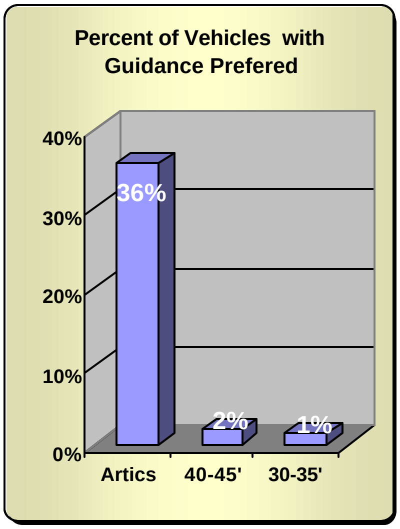


Exhibit 19 Percentage of Potential Deliveries preferring Vehicle Guidance

Virtually no (1-2%) other size BRT vehicles were considered as candidates for vehicle guidance systems. Exhibit 19 shows that for 40-45' buses about two percent (2%) preferred seeking guidance systems for those vehicles and for 30-35' buses the number was more approximately one percent (1%).

4.5.5 Articulated Bus Noise Reduction

Along with the growing interest in the image of BRT and bus transit, there is now increasing interest in a major factor that impacts both the rider (customer) and the community served by BRT. Noise reduction in both interior and exterior zones has become an issue that is beginning to be included in BRT vehicles specifications. Exhibit 18 shows that a little over 50% of the articulated buses plan to seek lower noise in and surrounding the vehicle. The concern is raised much less often when planning a BRT service with the 40-45' vehicles or even 30-35' buses. This preference is more often expressed by communities that tend to select the advanced image artics and that also have desire to select the most advanced support features currently available.

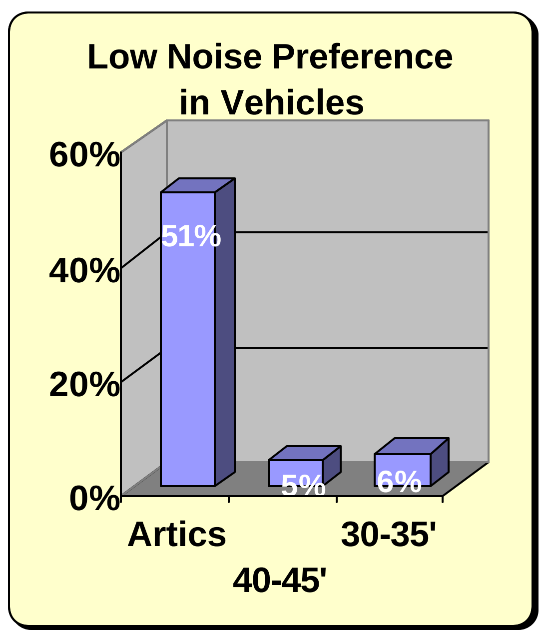


Exhibit 20 Low Noise Preferences in Vehicles

4.6 Preferences in 40-45' Buses

The next largest group of BRT vehicles by type is the 40-45' conventional low-floor buses. Out of 5210 buses, 1184 deliveries are projected to be of this type bus. The preferences expressed by the BRT communities about these vehicles are sufficiently different from the artic preferences to warrant this separate section.

4.6.1 Propulsion and Fuel for 40-45' Buses

The principle selection for propulsion systems for the conventional 40-45' bus is an internal combustion engine. Ninety-five percent (95%) prefer the ICE and only five percent (5%) are planning hybrid versions for their BRT service vehicles, as shown in Exhibit 21. This is despite the purchase of such hybrid vehicles by transit properties for their normal transit bus operations. However, at least thirty-eight percent (38%) of the vehicle deliveries in the ICE selection were also considering hybrid drive trains. When totaling the combination of planned and considering hybrids of the projected vehicle deliveries, forty-three percent (43%) fall in the hybrid drive train selection category and fifty-seven percent (57%) are powered by ICEs. This data is illustrated in Exhibit 21 which also shows that dual mode drive trains are not considered for the BRT service applications in the 40-45' buses. The results at 43% for the hybrid split in that case is comparable to the artic results at 44%. The ICE split is a little higher at 57% since no dual-mode preference was expressed for the 40-45' buses in these results.

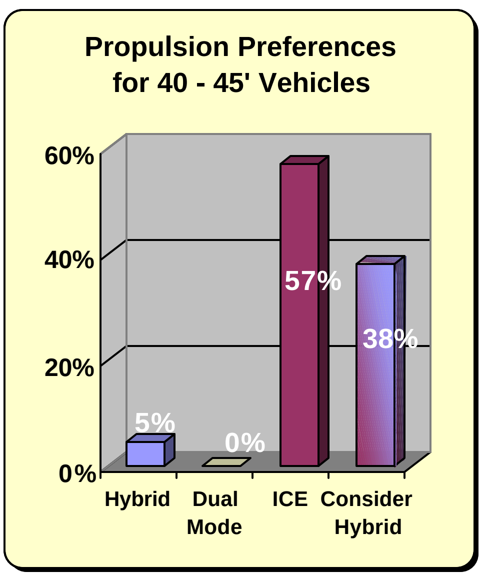


Exhibit 21 Vehicle Propulsion Preferences for 40-45' Buses

The fuel preferences differ from the artic choices but the highest rated fuel is again CNG as shown in Exhibit 22. The no-preference category is much higher and the diesel selection is double the artic percentage. Surprisingly ULSD is a lower value but LNG is planned by some of the communities. No gasoline fuel or bio-diesel fuel was a choice by the BRT planners for 40-45' buses.

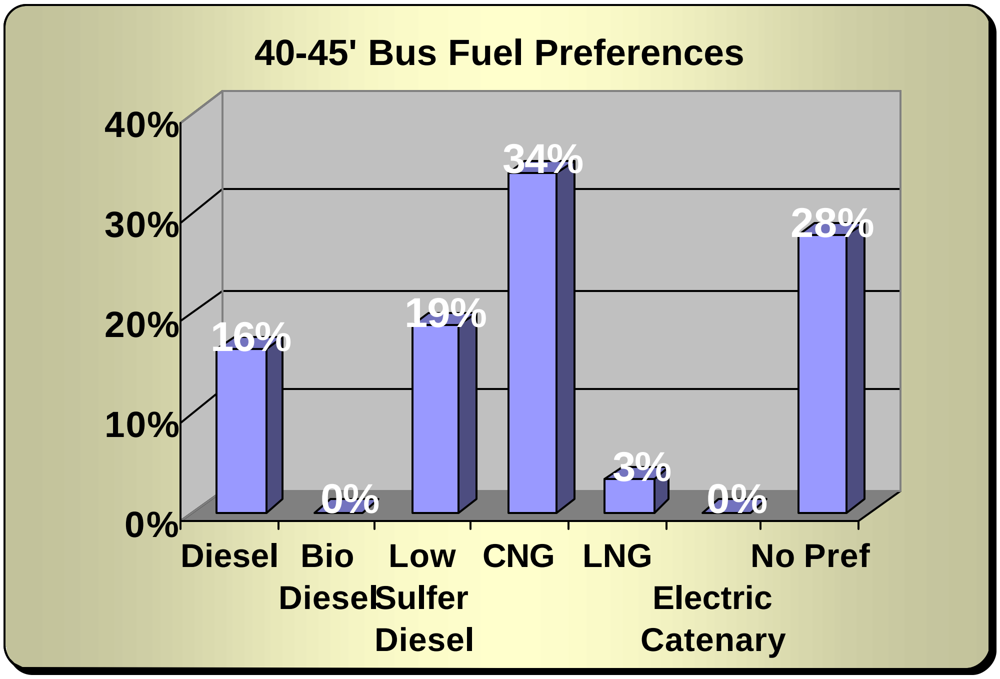


Exhibit 22 Fuel Preferences for 40-45' Buses

4.6.2 Door Preferences in 40-45' Buses

The number of doors preferred by BRT communities for the 40-45' vehicles revealed that at least fifty-six percent (56%) planned the conventional two doors as shown in Exhibit 23. Surprisingly forty-three percent (43%) had not yet planned the number of doors. Also, the size and type of doors in both cases were not available from the planners. Less than one percent (1%) considers requesting a 3-door configuration. With a low-floor entry, a three-door 40' bus severely reduces the seating capacity but can reduce dwell time if all three doors allow entry. Three-door entry in that case usually means some form of cashless fare.

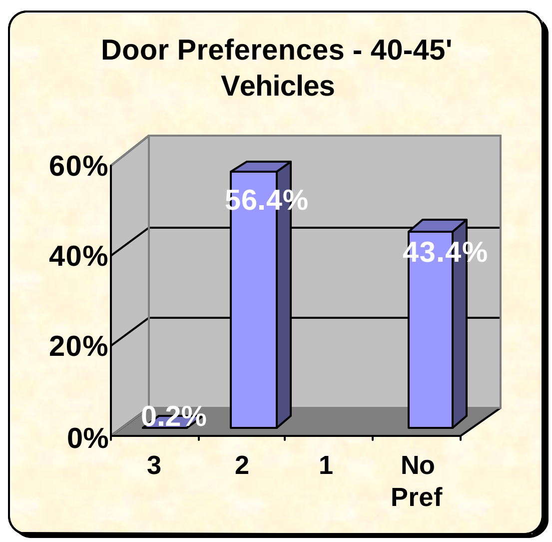


Exhibit 23 Door Preferences for 40-45' Buses

4.6.3 Appearance, Guidance and Noise in 40-45' Buses

The most striking difference for these buses as compared to the BRT artics is the reversal of image preferences. Exhibit 24 contrasts and compares the results in selection of image for the artics and 40-45' buses for BRT. As Exhibit 24 shows, a very few, about twelve percent (12%), feel an advanced image is needed for 40-45' vehicles. Instead at least seventy-one percent (71%) prefer a bus with a distinctive image which means a distinctive livery but includes logos and branding. These preferences also parallel the low interest in docking guidance or narrow-lane assist at two percent (2%) and noise reduction at five percent (5%). Some of the exclusive rights-of-way planned for these vehicles are next to a freeway, which explain the lower interest in noise reduction.

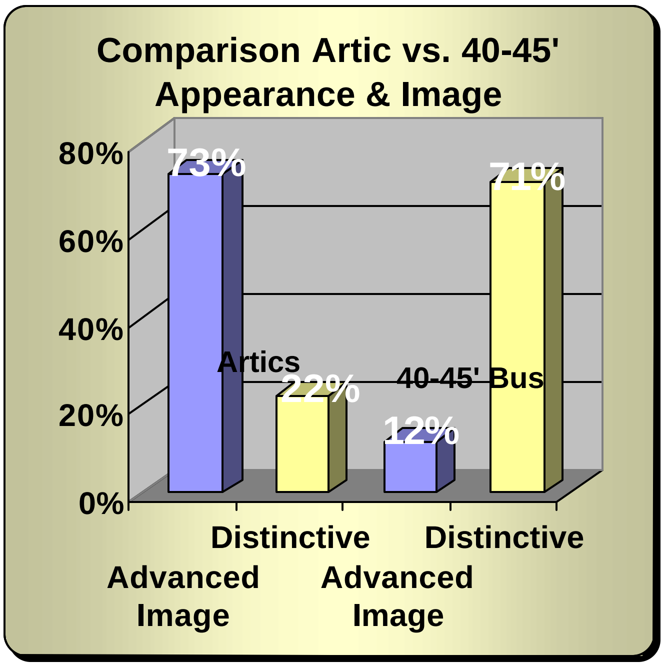


Exhibit 24 Appearance Comparison Artic vs. 40-45' Bus

4.7 Preferences for 30-35' Buses

This section captures the preferences for the 30-35' buses planned for potential delivery by the BRT communities. The quantities in this case are small representing fifteen percent (15%) of the vehicles relative to the quantities of other vehicles as shown in Exhibit 25. Only five communities are planning deliveries of these to enhance the service in exclusive ROWs or add a new service that has all the elements of BRT but serves more in a dual role of a feeder service and local demand response for the general ridership. Low floors or step-low floor are the majority preference. The propulsion preference is clearly oriented to ICE at seventy-three percent (73%) as shown in Exhibit 26; however, a transit property is planning delivery of a large quantity, twenty-seven percent (27%), of the potential vehicles equipped with hybrid drive trains.

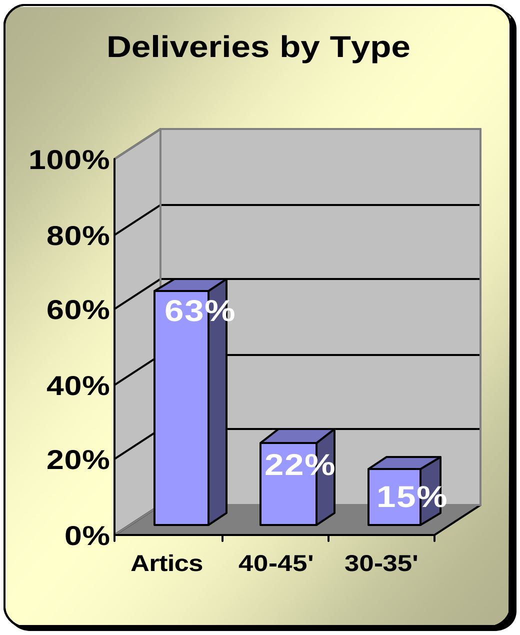


Exhibit 25 Vehicle Quantities by Bus Type

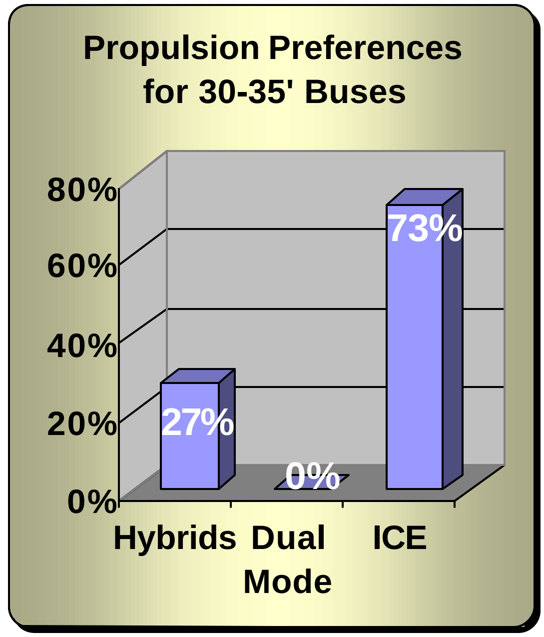


Exhibit 26 Propulsion Preferences, 30-35'

The dual mode drive system is not planned for any of these vehicle deliveries. Fuel selection preferences seem to favor conventional high-sulfur diesel. As shown in Exhibit 27, conventional diesel is selected as a fuel for seventy percent (70%) of the quantities while ULSD comes in at twenty-two percent (22%). Alternative fuels do not appear to play a large role despite the plan for use of the majority of these vehicles in the local neighborhood. Bio-diesel, as with the other BRT vehicles is not a preference, while CNG is slated for five percent (5%) of the vehicles and none expect to use LNG. Only four percent (4%) of these vehicle quantities have no preference as yet for fuel. The high percentage for diesel fuel is a result of plans for near term purchase of these vehicles, prior to 2007. The small relative quantities of these vehicles tend to exaggerate the percentages shown.

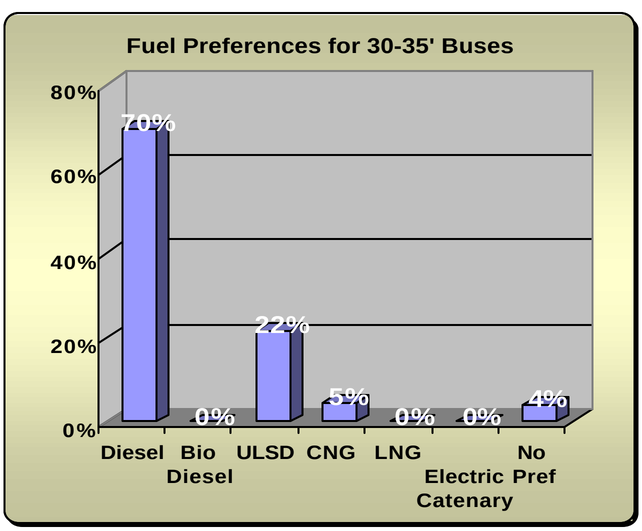


Exhibit 27 Fuel Preferences for 30-35' Buses

The preference for image is another surprise that does reflect the proximity of operation to the community. Exhibit 28 compares the preferences for image of the 30-35' buses with the other principle types, artics and 40-45' vehicles. Although the quantity is between 4 and 5 times less, the preference for an advanced image relative to a distinctive appearance is comparable to the results for the artics and clearly opposite of the 40-45' vehicles. There is a distinct interest in sleeker more modern looking vehicles that denote BRT levels of service. The door preference is primarily 2 doors with a ninety-five percent (95%) preference. The other five percent (5%) reflects a no preference choice. As mentioned previously, guidance had a 2% preference and reduced noise only a 5% preference.

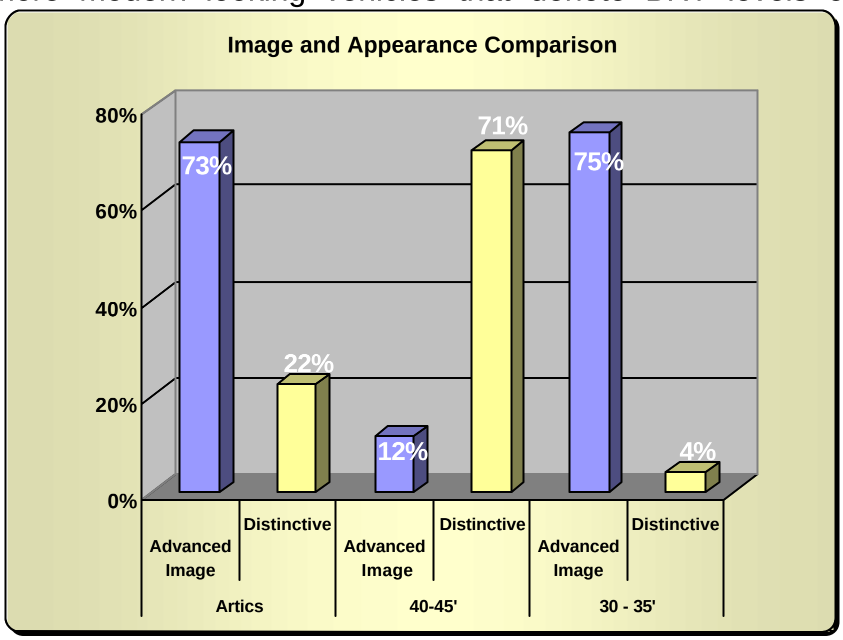


Exhibit 28 Image and Appearance Comparison

4.8 Infrastructure and Other BRT Component Preferences

Although the focus is on vehicles in this analysis and since BRT is a service system not just a vehicle, information naturally flows from the documents and from the interviews regarding other BRT components. This subsection provides the results here in terms of the percent of corridors out of the total of one hundred thirty-five (135) reported on from the communities. Exhibit 29 shows a list of components down the left side, ordered by preference percentage as a convenience.

Signal priority was most often mentioned for over fifty-four percent (54%) of the aggregate corridors being contemplated by transit planners. Next, off-board or

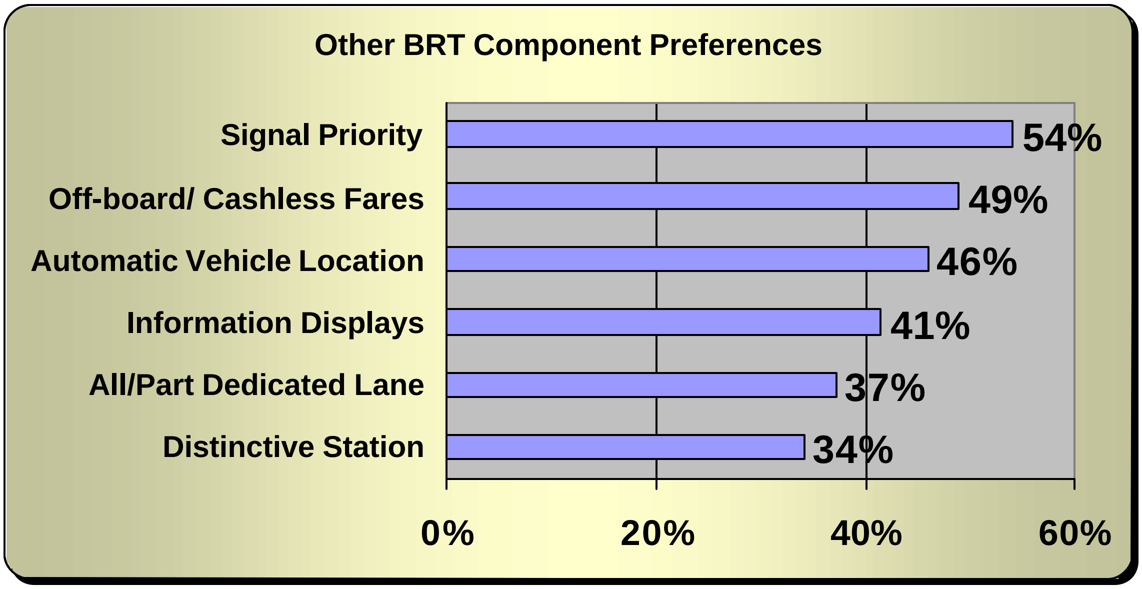


Exhibit 29 Preferences in Other BRT Components

cashless fare collection was next at forty-nine percent (49%). Many communities are implementing automatic vehicle location (AVL) technology (46%). Information displays on the vehicle and occasionally at stops were noted for forty-one percent (41%) of the corridors.

At least thirty-seven percent (37%) of the corridors had all or part of the route with some form of the dedicated lane treatment. This ranged from dedicated transit ways and shared transit-ways to painted lanes with enforcement. This is lower than the 2002 Analysis, which had at least 57% of the corridors with some form of dedicated lane treatment.

Fully one-third of the corridors were planning a “distinctive station” which usually meant, as a minimum, an enhanced shelter with logos and branding and often with amenities. Some with cashless fare equipment would locate the equipment at these stations also to give a rail-like “feel”. In some cases, these stations were structures or buildings that served multiple routes with a multi-bay design and some were even transit centers.

5.0 Observations and Comments on Results

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5.0 Observations and Comments on Results

This Section 5 builds on the major findings and results described in the previous section by providing additional observations and comments. Also, after detailed discussions with the bus manufacturing sector and the FTA, the data is evaluated critically to answer some questions raised by the manufacturers. This section provides responses and comments drawn from the data.

The first Subsection 5.1 evaluates the results relative to the original analysis published in 2002 and also provides observations about the vehicle data in this report. Subsection 5.2 comments on the potential for segmentation in the transit bus market as a result of growth in BRT implementations. The larger transit properties tend to plan greater BRT vehicle quantities so Subsection 5.3 looks at the effects on preferences and annual delivery quantities of vehicles. The BRT vehicles, especially the artics, have more advanced technologies so their prices are higher than vehicles purchased for the local transit services. The effect of purchase price is addressed in Subsection 5.4 with comments on the overall market dimensions for manufacturers. The final Subsection 5.5 discusses the possible gaps in data and suggests possible follow-on efforts that might offer a solution.

5.1 Some Key Similarities and Differences

A key similarity between the 2002 published analysis and this 2004 update is that the quantity of vehicles by type, as percent of the total planned vehicles, is consistent as shown in Table 6. The 60-65' articulated vehicles planned for BRT service is about the same at sixty-two percent (62%) for 2002 and sixty-three percent (63%) in this update. The 40-45' buses dropped slightly from 25% to 22% while the 30-35' bus quantities rose slightly from 13% to 15%. This percentage breakdown, 63%, 25% and 15%, respectively is still substantially different from the APTA five-year projections for new vehicle orders at 7%, 67% and 22% for the U.S. transit industry.

Annual delivery rates for artics nationwide are also similar to the 2002 findings. The rates here start at over 200 units annually and rise to over 350 per year, which is slightly lower than the 400 units per year in the previous work. Whether these are “replacement” and “new expansion” vehicles is a question raised by the manufacturing sector. A separate discussion, in Subsection 5.2, follows with more on that subject.

The Table 7 compares the results from the 2002 analysis to this 2004 data set for key feature preferences in the vehicles. There is a slight drop in the quantities of articulated vehicles preferred with the sleek, modern, rail-like appearance. There is increased interest in hybrid drive trains since transit properties may potentially consider equipping 24% of the vehicles with hybrids over ICEs. The numbers for drive choice in 2004 without parentheses represent the total potential quantities and the percent in parentheses represents the results if the communities chose ICE instead. A similar choice was not offered in the 2002 analysis.

Table 7 Key Measures Comparisons - Vehicle Types and Feature Preferences

Category	2002 Analysis (Percent)	2004 Analysis (Percent)
Vehicle Quantities by Type		
60-65' Articulated Buses	62	63
40-45' Buses	25	22
30-35' Buses	13	15
Key Preferences 60-65' Articulated Vehicles		
Image – Sleek, Modern, Rail-Like	79	73
Internal Combustion Engine Drive	68	52 (70)
Hybrid Drive – Planned and Potential	32	49 (24)
Fuel	CNG 43 ULSD 23 Diesel 34	CNG 45 ULSD 39 Diesel 5
Reduced or Low Noise	42	51
Docking Guidance	36	36
Key Preferences for 40-45' Buses		
Image – Sleek, Modern, Rail-Like	3	12
Internal Combustion Engine Drive	98	57 (95)
Hybrid – Planned and Potential	2	41 (5)
Fuels	CNG 21 ULSD 10 (Undecided 54%)	CNG 34 ULSD 19 Diesel 16
Reduced or Low Noise	~ 0	5
Docking Guidance	< 1	2
Key Preference for 30-35' Buses		
Image – "Unique, Advanced Image"	96	75

The fuel choice preference remained about the same for compressed natural gas (CNG) but the planned used of ULSD as fuel almost doubled accompanied by a large drop for conventional diesel. Noise control interest grew a few percentage points and interest in docking guidance remained constant.

The 40-45' bus preferences again showed little interest in advanced image, opting for primarily a "distinctive image" with branding and logos. More vehicles were being considered for hybrid drive than in the 2002 results but actual planned quantities were about the same percentage-wise. Fuel choice is hard to compare because such a large group were undecided in the first analysis in 2002. Essentially no change occurred in preferences for noise control and guidance for these vehicles. Preferences for the 30-35' were about the same including the interest in "unique, advanced image" buses.

This discussion describes the robustness of the findings in terms of the size of properties submitting the preferences. About nine of the communities contacted, such as Los Angeles, Miami, New York or Seattle, plan the delivery of large quantities of vehicles compared to the balance of the transit properties. Those transit properties' vehicle quantities were removed for construction of Exhibit 32, which then reflects the vehicle preferences as in Section 4.0. As can be seen in Exhibit 30, by comparing the vehicle features listed on the left side and the

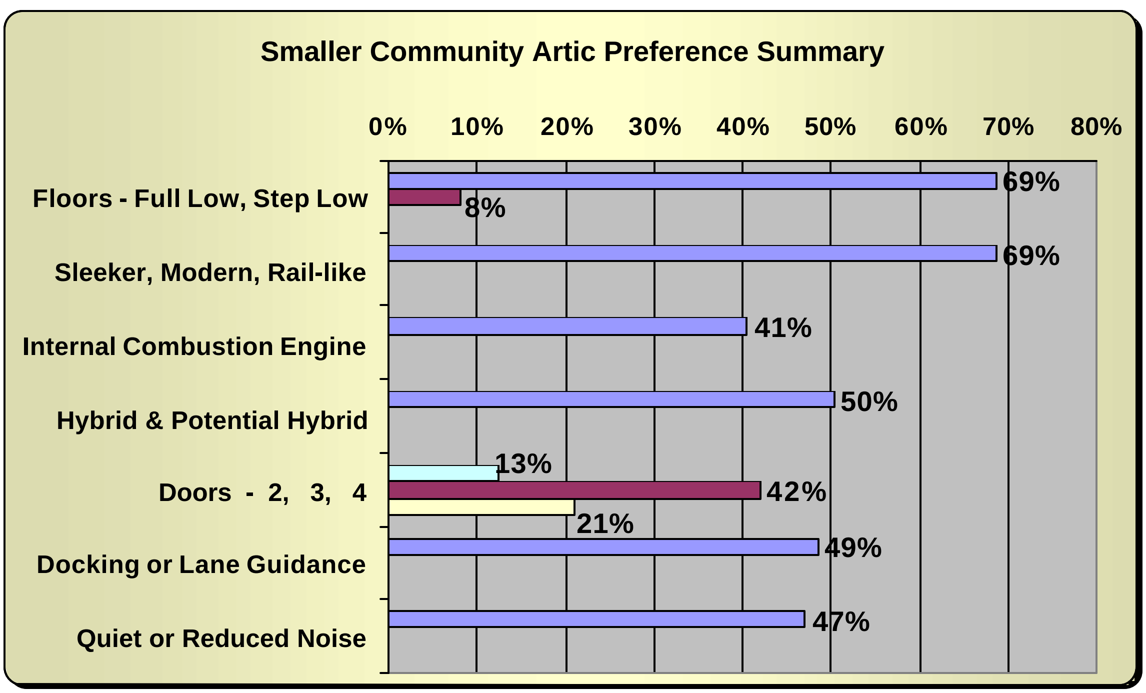

Exhibit 30 Summary of Artic Appearance and Feature Preferences Less Larger Communities

corresponding percentages to those for the total population of articulated vehicles in this analysis as shown in Exhibit 31.

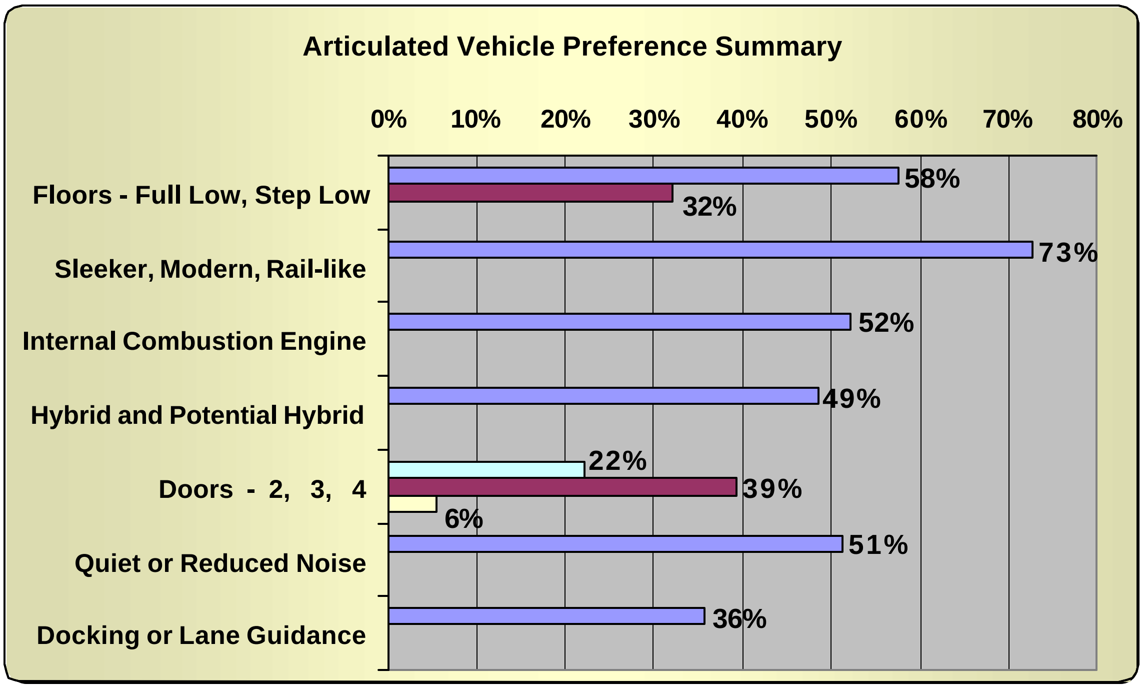

Exhibit 31 Articulated Vehicle Preference Summary

Four to six BRT communities were being added per year at the time of the 2002 analysis and that trend continues in this data. The quantities of potential vehicle deliveries for some of the original communities have decreased from the 2002 values. This occurs with planning in the transit industry nationwide apparently. On the other hand, since more communities are joining this opportunity for enhanced service, more vehicles are being added to the planned deliveries.

Exhibit 32 provides a top-level comparison of vehicle quantities for the 60-65' articulated vehicles, the 40-45' buses and the 30-35' buses for three situations. The left most values for each vehicle type are from the 2002 analysis (pro-rated to a ten year value since eleven years were presented in the 2002 Analysis). The next bar for each vehicle type shows the previous effect, when the quantities are cut back and are replaced by new vehicles from other communities within the same group of communities. The right-most bar for each vehicle type represents the vehicle quantities from the 2004 analysis. When comparing the outer-most bars, the growth of vehicle quantities is related to growth in the total number of communities. Two points do not make a trend, however this may be a topic for revisiting in the future.

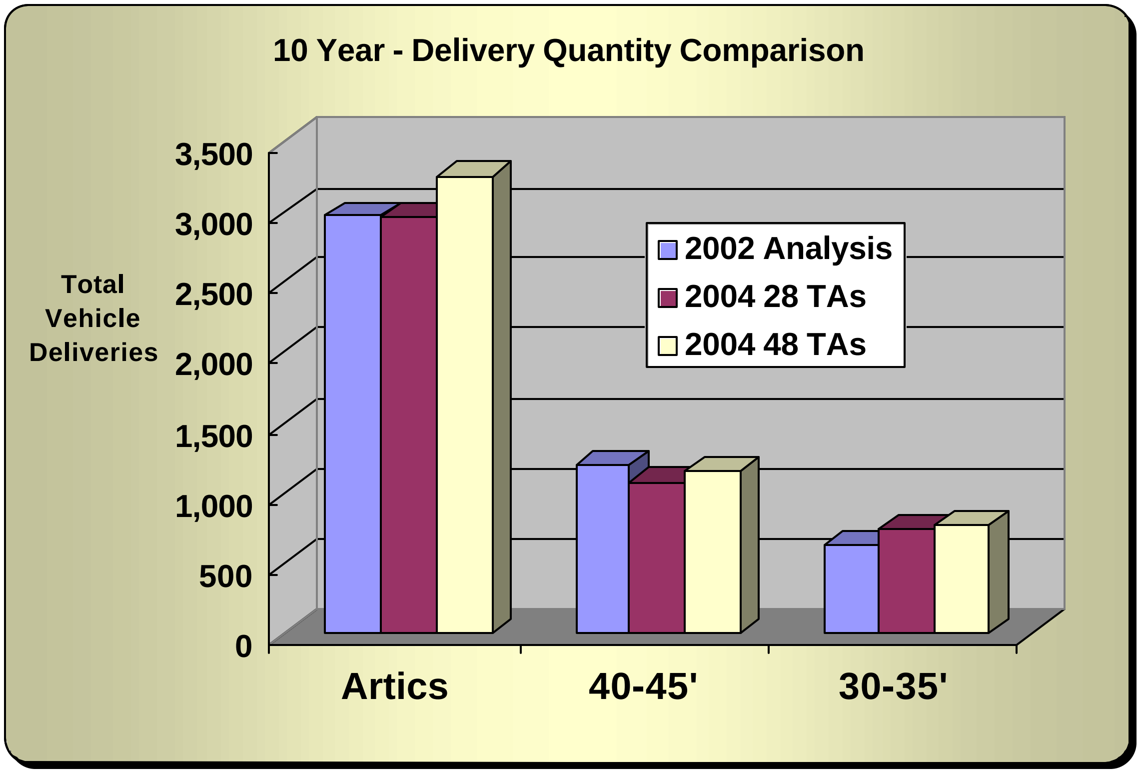

Exhibit 32 Delivery Quantities Comparison over 10 Years

5.2 Market Segmentation – New or Replacement Vehicles

Another issue raised by the manufacturing community was classification of the vehicles being delivered. The concern is whether the vehicles planned for delivery are either "replacement" vehicles or "new expansions" vehicles. The interpretation of a replacement vehicle is one that replaces another vehicle that is being retired or leaving service. The intent is to determine whether the BRT vehicles projected in this report relate to the normal transit market planning on an annual basis.

This is difficult to ascertain directly. For some instances such as Seattle, some regard the deliveries for the tunnel vehicle as "replacement" vehicles because no new routes are really being added just some of the BRT infrastructure. LACMTA on the other hand also considers their vehicles as "replacement" but the Metro Rapid buses have not displaced the local service, which continues to operate.

Other communities are planning the additional vehicles as an overlay of service to reduce projected congestion and reduce emissions.

Working with the basic survey input quantities for APTA's latest projections on potential orders (2003 to 2008), a community-by-community comparison was made to the potential deliveries in this Analysis Update. The year vehicles are delivered is later than the year an order is placed so the APTA projection time frame is not the same as this analysis. Ignoring the time span difference, twenty-three percent (23%) of the artics and thirty-eight percent (38%) of the 40-45' foot buses are in both databases. This effect reflects that the purchasing department and long range planning in transit properties tend to be different parts of the organizations. There was no overlap with the 30-35' buses.

The comparison of databases does not provide sufficient information alone to determine is an "expansion" market is developing. However, the preferences in the 60-65' articulated vehicles are distinctly different than the traditional replacement market vehicles, even though the vehicles may ultimately replace service vehicles and increase capacity.

The 40-45' buses may well be another matter. First, the projected quantities from APTA are larger than the quantity from the few transit properties in this analysis. Coupled with the reduced interest in advanced image, guidance and noise reduction, there is definitely room to consider these as replacements buses that provide enhanced service.

5.3 Transit Property Size and Annual Vehicle Quantities

Another question of interest to the bus-manufacturing sector is the size of an annual order quantity for these BRT vehicles. A proxy for the "order" quantities in this report is the size of the annual deliveries planned. Exhibit 33 provides a distribution that includes all types of vehicles and all the communities. The average (mean) delivery quantity is 28 vehicles, the median is 18 and the mode is 14. Note that only two (2) communities expect annual quantities near one hundred (100), which was suggested as necessary to offset a sizable investment.

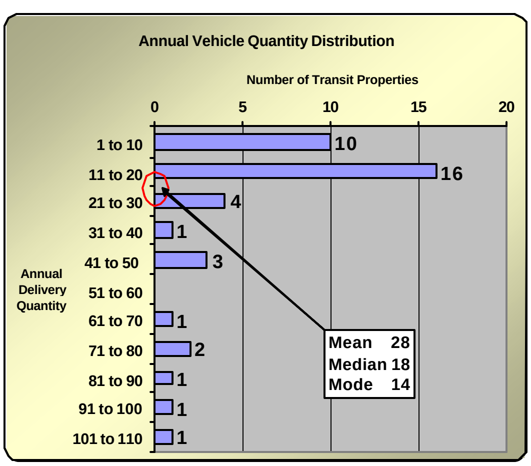

Exhibit 33 Annual Vehicle Deliveries Distribution

The Exhibit 34 shows the average annual delivery quantities by community. Only ten (10) communities exceed the group average of 28. These smaller quantities

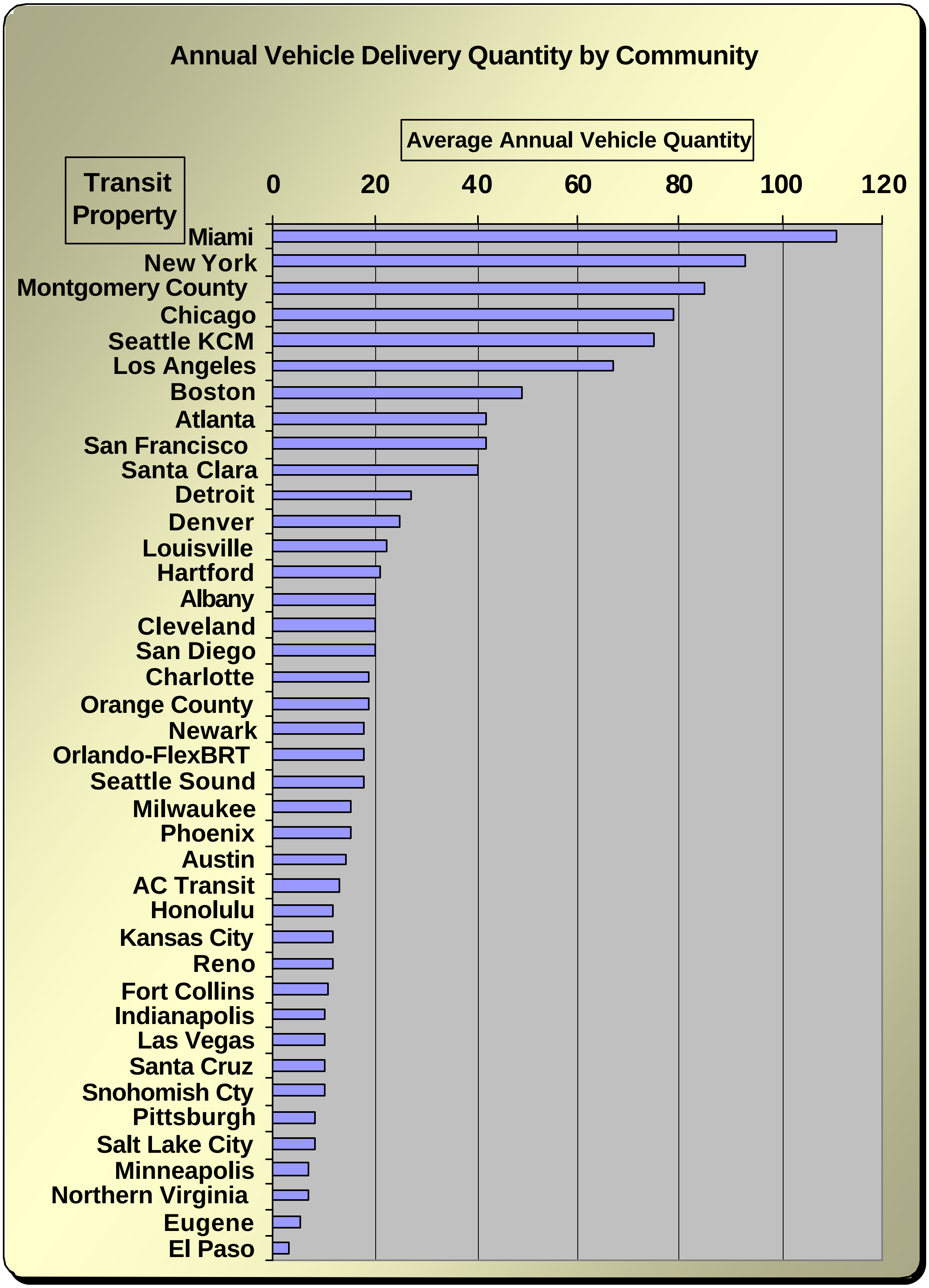

Exhibit 34 Distribution Average Annual Delivery Quantity by Community

Impacts the ability of the manufacturing sector to respond to the interest in new vehicle features and technologies with proper and timely investments.

5.4 Market Capital Perspective

The annual transit market in 2003 included about 450 articulated buses, about 2,000 40-45' buses and 580 30-35' transit buses. Using the average purchase price numbers in APTA's 2004 Fact Book, that quantity of vehicles represents about a $1 billion annual capital investment.

The projected average annual BRT vehicles are 325 articulated buses, about 115 40-45' buses and 80 30-35' buses. BRT vehicles, as indicated in this analysis, may include CNG fueled engines or diesel hybrid-electric drive systems especially in the BRT artics. Some even may be delivered with additional styling features and amenities or even high-technology features like docking guidance. The pricing for these artic vehicles is a significant increase over the traditional average price for transit market artics. The 40-45' and 30-35' BRT vehicles may also have some price increments; but assuming comparable pricing to transit market averages, a total capital BRT investment can be estimated.

The BRT vehicle market is estimated at a total capital investment annually of almost $300 million. In terms of vehicle quantities that annual amount represents only fifteen to seventeen percent (15-17 %) of the 2003 transit industry wide figures for the same length vehicles. But that estimate, in cash, represents twenty-five to thirty percent (25-30%) of the annual capital investment for the same length vehicles.

5.5 Potential Follow-on Analyses

During the development of these results, a number of topics were describe that may be helpful to pursue in the future. The following topics may prove important future information for the industry going forward with BRT service implementations.

- A large percentage of communities are considering hybrid-electric drive. An increased understanding of the factors affecting the community choices may offer a potential future analysis task.

- Noise reduction and increased rider comfort features in vehicles was noted as an important and growing preference. The potential impact of hybrid-drive systems versus internal combustion engine drive may offer a fruitful subject for an investigation, especially with industry and manufacturer participation.

- Docking guidance continues to be of interest for at least a third of the vehicles. Efforts to move this technology forward to commercialization through risk reduction in the transit industry appear an important candidate for the near future.

- Finally, more in-depth analysis of acceptable pricing for selected features in vehicles, especially high-technology items may also serve to accelerate implementation of BRT service.