

# Fuel Cell Bus Market Study:

*Transit agency needs,  
wants, and concerns*

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Presented at APTA Expo Oct 13 2014

# Our Mission is to Make Clean Transportation Happen

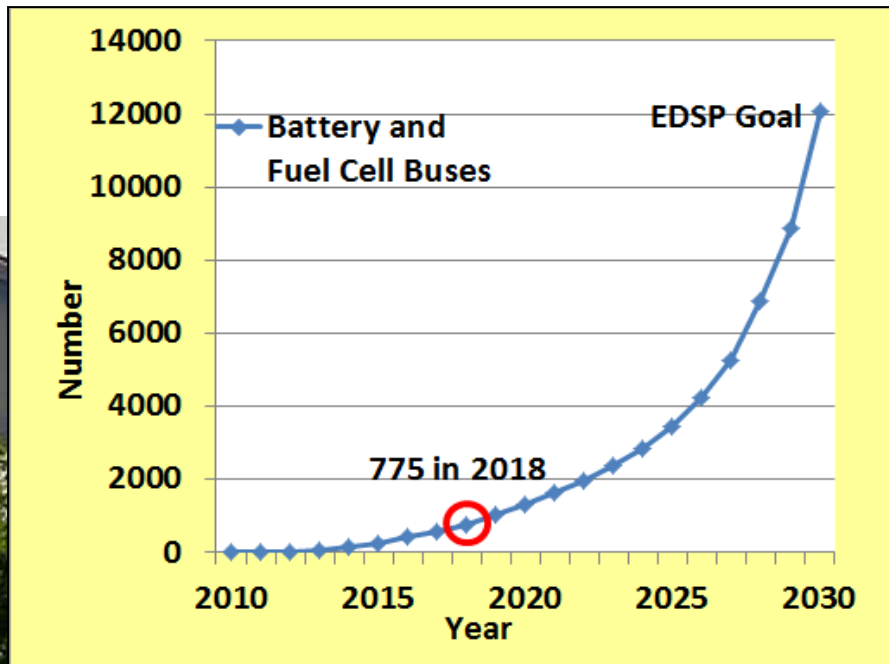
**CALSTART is a unique national, non-profit, member-supported organization dedicated to the growth of an advanced transportation technologies industry that will:**

- » **Create high-quality jobs;**
- » **Clean the air;**
- » **Reduce dependence on foreign oil; and**
- » **Prevent global warming**





# Our 2018 Goal: 775 ZEBs by 2018!



FTA EDSP Goal – 2030

- 12,000 ZEBs

CALSTART 2018 Goal

- 775 ZEBs  
(in service or on order)

Extrapolated to 2014

- 136 ZEBs



# CALSTART Members (Partial Listing)

## Making Clean Transportation Happen. Join Today.



# Overview of our FCB Market Study

- \* Ongoing initiative to capture the needs of the transit industry.
- Three phases:
  - Interviews of leading properties
  - Nationwide survey of transit executives
  - Focused general manager charrette
- Goal: provide information to the FCB industry on the wants, needs and anticipated demand for FCBs. (Dec 2014)
- Today's work: desired attributes, concerns, trade offs.
- Next steps: purchase price sensitivity, demand projections.



# Survey Methodology and Timing

## Data Collection Method

- Written survey distributed by e-mail Feb 2013
- Request for 2 participants per agency (*if possible*) who influence bus procurement
  - Fleet Manager (Fleet Supervisor/City Transit Executive/Procurement Manager)
  - Maintenance Manager

## Participants Selected Based on:

- Various levels of AFV bus experience
- Various sizes of transit bus fleet
- Locations throughout the U.S. in pollution non-attainment and maintenance area

## Outreach:

- 69 agencies contacted
- 41 agencies responded
- 53 transit executives responded (26 with *ZEB exp.*)
- Fleet Managers: 30 total (10 with *FCB exp.*; 7 with *battery electric bus exp.*)
- Maint. Managers: 23 total (6 with *FCB exp.*; 3 with *battery electric bus exp.*)

## Survey Participant by AFV Experience Level

AFV Experience Level of Transit Agencies Responding to Survey	Number of Transit Agencies Represented
Have CNG Bus & Refueling Infrastructure Experience	24
Have Battery Hybrid Electric Bus Experience	16
Have Fuel Cell Bus Experience	12
Have Battery Electric Bus Experience	8
Have No AFV Bus Experience	2

# We identified potential early adopters

Willing to Install  
Hydrogen  
Refueling  
Infrastructure



Have  
Exp.  
With  
CNG

as a  
Fuel

**Potential  
Early  
Adopter**



Interested  
in  
FCBs



# Desired attributes: *Which are most important?*

Attribute	Early Adopters	All Participants	
Better fuel economy (\$\$/mile)	4.5	4.6	} <u>Most Important</u> Reliability, Emissions, Fuel Economy
Eliminates GHGs	4.5	4.2	
Improved reliability over diesel buses	4.3	4.4	
Eliminates tailpipe (PM, NOx, CO)	4.3	4.2	
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“Green Bus” Passenger Appeal	3.8	3.3	} <u>Less Important</u> Public Perception, ZEB Mandates
Fewer Mechanical Components	3.8	3.5	
Meets ZEB Mandates	3.7	3.7	
Public Presentation / Politics of it	3.5	3.5	
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Silent Operation	3.0	2.6	} <u>Least Important</u> Operating Benefits, Driver Appeal
Improved bus driver appeal	2.7	2.5	

# Pain Points

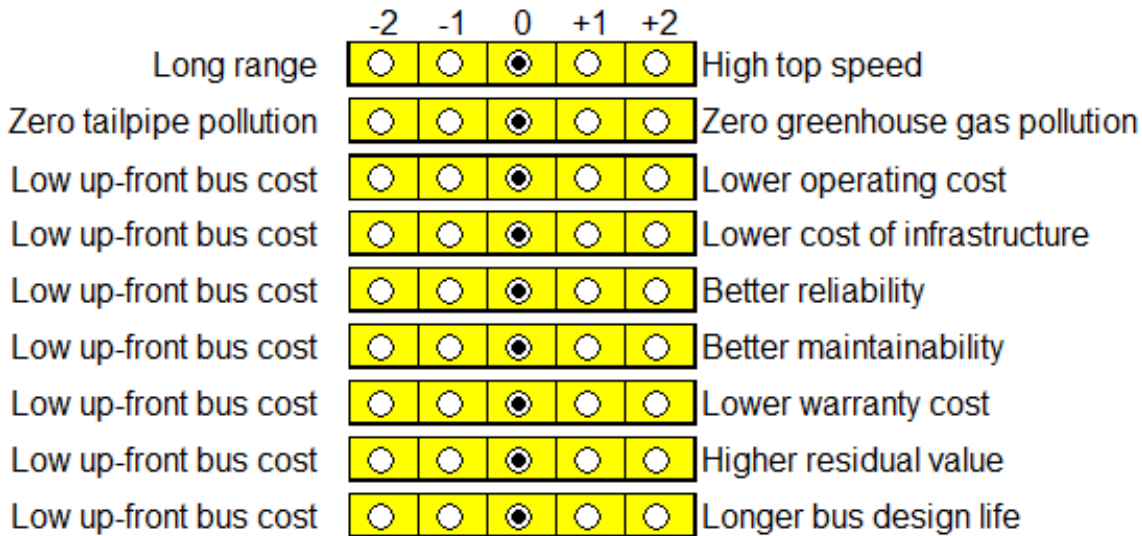
## *What are your greatest concerns?*

Attribute	Early Adopters	All Participants	
Vehicle Availability	4.6	4.7	} <u>Most Important</u> Availability, Long-term support, Purchase Price
Long-term supplier support	4.5	4.6	
Purchase Price	4.5	4.7	
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Concerns about system life	4.2	4.4	} <u>Less Important</u> Maintenance Safety, Training
Concerns about safety / new hazards	4.2	4.3	
Warranty Inadequacy	4.1	4.2	
Maintainability/Fit with Current Fleet	4.1	4.4	
Lifecycle cost estimates will not be achieved	3.9	4.1	
Liability	3.8	4.0	
Availability of maintenance training	3.8	4.1	
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Don't want to be an early adopter	2.8	3.0	} <u>Least Important</u> Residual Value, Driver Input
Vehicle residual value	2.8	2.5	
Drivers will not like	2.8	3.0	

# Trade Off Analysis

## *Which one would you prefer?*

Attribute Pairs:



Trade-off questions reveal transit agency priorities.

Respondents chose *strong preference, weak preference, or no preference*

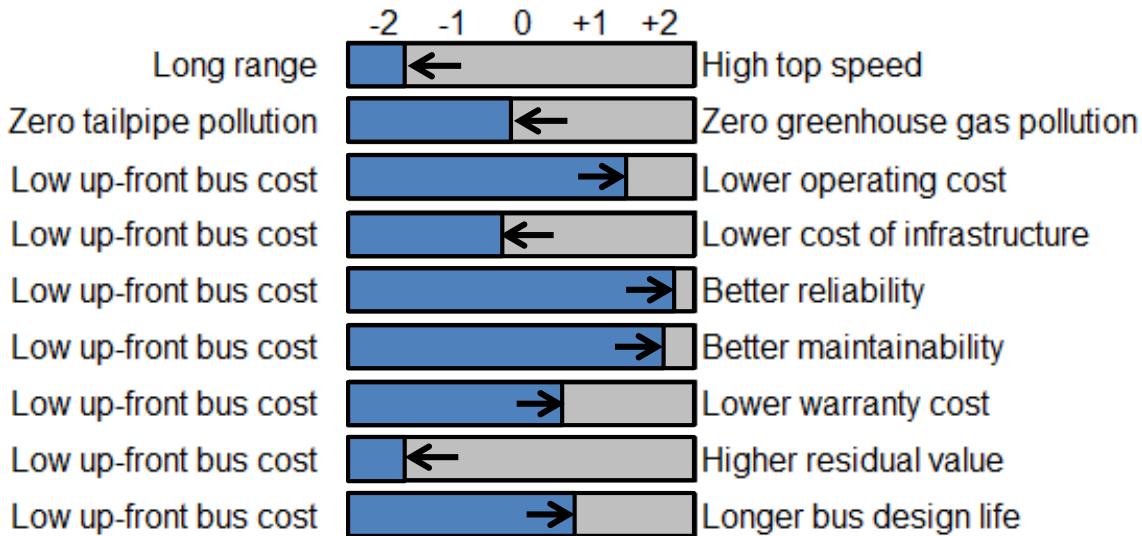
Focus on bus cost trade-offs



# Trade Off Analysis

## *Which one would you prefer?*

Attribute Pairs:



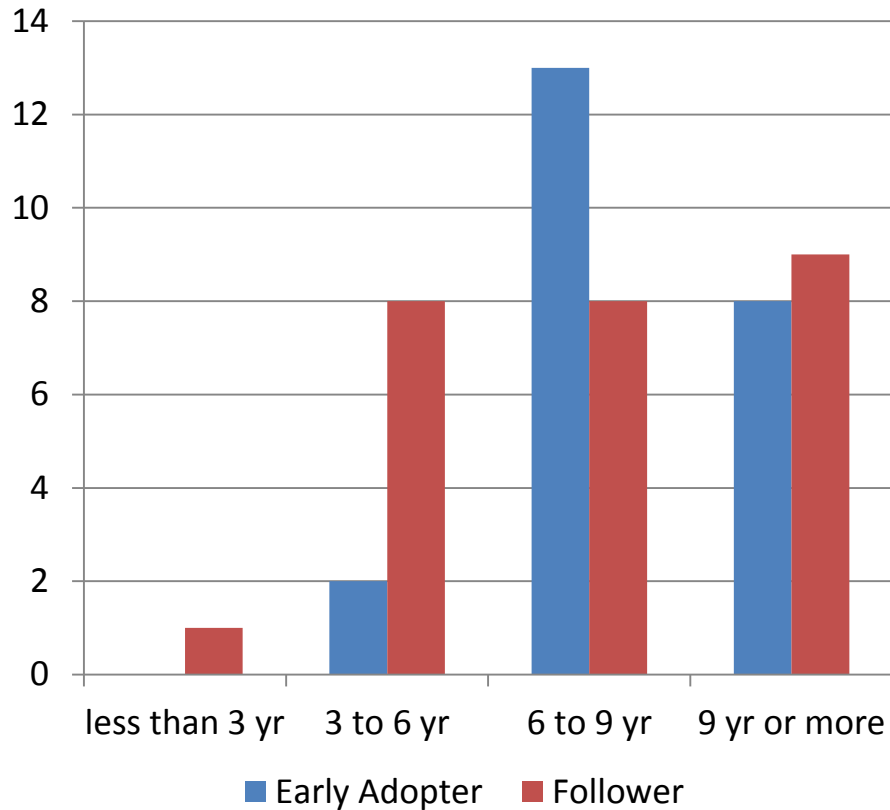
### Key findings:

Strong weighting towards long range over high top speed.

Weak preference for zero tailpipe vs. zero GHG.

While up front cost is a concern, respondents weighted it less important than nearly all other metrics.

# Expected Payback



Expected Payback Period

Query: when investing in a new technology bus, what is the minimum acceptable payback period?

Findings:

- Early adopters willing to tolerate later payback periods
- 35% willing to tolerate 9+ years – essentially a “break even bus”

# Insights for Zero Emission Buses

- Survey results confirm that agency managers overwhelmingly focus on concrete issues – costs, reliability, maintenance. Softer issues like public perception do not resonate. *FCB industry and proponents need to tailor their messaging accordingly.*
- Reliability and maintenance is the greatest concern. Good news, FCBs are starting to meet these targets. This is a major win for FCBs.
- H2 costs (\$/kg) remain high, and fuel cost/mi is the #1 agency concern. The infrastructure piece may become a major bottleneck. What can OEMs and component suppliers do to overcome this?
- While agencies are concerned about upfront costs, they are *more* concerned about reliability and operating cost. Take home: OEMs should focus on building a high quality bus, let prices fall in the long term.



**Questions? Comments? Please reach out.**

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# Agencies Participating in Survey

Count	Location	Survey Participant
1	Albuquerque, NM	City of Albuquerque Transit
2	Atlanta, GA	Metropolitan Atlanta Rapid Transit Authority (MARTA)
3	Austin, TX	Capital Metropolitan Transportation Authority (CMTA)
4	Birmingham, AL	Birmingham-Jefferson County Transit Authority (BJCTA)
5	Birmingham, AL	Regional Planning Commission of Greater Birmingham (RPCGB)
6	Boston, MA	Massachusetts Bay Transportation Authority (MBTA)
7	Boulder, CO	City of Boulder Transit
8	Bremerton, WA	Kitsap Transit
9	Burbank, CA	BurbankBus
10	Burbank, CA	City of Burbank, CA
11	Charlotte, NC	Charlotte Area Transit System (CATS)
12	Chicago, IL	Chicago Transit Authority (CTA)
13	Chicago, IL	Pace - Suburban Bus Division (PACE)
14	Cleveland, Ohio	Greater Cleveland Regional Transit Authority (GCRTA)
15	Columbus, OH	Central Ohio Transit Authority (COTA)
16	Dallas, TX	Dallas Area Rapid Transit (DART)
17	Denver, CO	Denver Regional Transportation District (RTD)
18	Everett, WA	Community Transit
19	Flint, MI	Mass Transportation Authority (MTA) of Flint, Michigan
20	Harford-Stamford, CT	Connecticut Transit (CTTRANSIT)
21	Kansas City, MO	Kansas City Area Transportation Authority
22	Los Angeles, CA	Orange County Transportation Authority (OCTA)
23	Los Angeles, CA	Los Angeles County Metropolitan Transportation Authority (LACMTA)
24	Miami, FL	Broward County Transportation Department (BCT)
25	Nashville, TN	Nashville Metropolitan Transit Authority
26	New York, NY	MTA New York City Transit
27	Oakland, CA	Alameda-Contra Costa Transit District (AC Transit)
28	Olympia, WA	Washington State DOT
29	Phoenix, AZ	City of Phoenix Public Transit Department (Valley Metro)
30	Portland, OR	Tri-County Metropolitan Transp. District of Oregon (TriMet)
31	Salt Lake City, UT	Utah Transit Authority (UTA)
32	San Diego, CA	San Diego Metropolitan Transit System (MTS)
33	San Francisco, CA	San Francisco Municipal Transportation Agency (SFMTA)
34	Stockton, CA	San Joaquin Regional Transit District (SJRTD)
35	Santa Barbara, CA	Santa Barbara MTD (SBMTD)
36	Santa Clarita, CA	Santa Clarita Transit
37	Santa Cruz, CA	Santa Cruz Metro
38	Seattle, WA	King County Department of Transportation (King County Metro)
39	Seattle, WA	Central Puget Sound Regional Transit Authority (ST)
40	Thousand Palms, CA	SunLine Transit Agency
41	Wenatchee, WA	Link Transit

# Desired Attributes

## *Which are most important?*

Here are a number of attributes of zero-emission buses. Which ones are important to you?	Importance (1, 3, 5)
Better fuel economy (\$\$/mile)	
Improved reliability over diesel buses (availability, pullout)	
Improve fuel economy	
Fewer mechanical components	
Silent operation	
Eliminates greenhouse gases / carbon dioxide emissions	
Eliminates NOx emissions	
Eliminates CO emissions	
Eliminates PM emissions	
Less mechanical complexity / fewer mechanical parts	
Innovation / public presentation / politics of it	
Meets ZEV, LEV, local government mandates	
Improved bus driver appeal of driving a green bus	
Improved passenger appeal of using a green bus	
Press perception that my transit agency is a green bus first-mover	

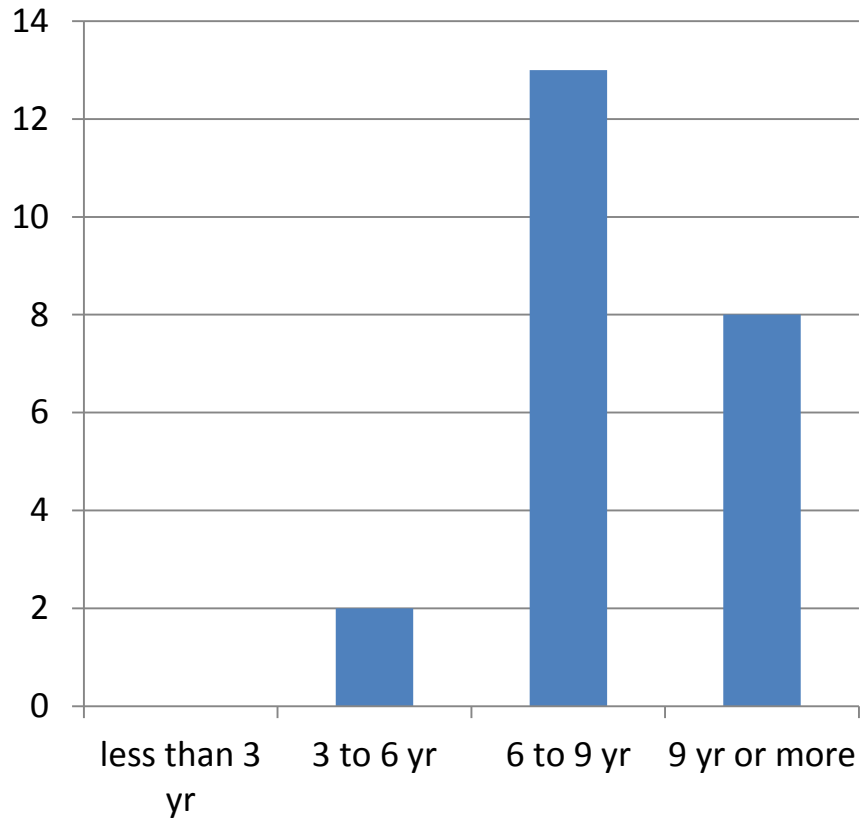


# Pain Points

## *What are your greatest concerns?*

<b>Here are a number of concerns transit agencies have voiced about zero-emission buses. Which ones are important to you?</b>	<b>Importance (1, 3, 5)</b>
Reliability/Up-Time/Breakdowns	
Purchase Price	
Maintainability/Fit with Current Fleet	
Degraded Functional Bus Requirements	
Drivers Will Not Like	
Suppliers Will Not Stand Behind Products	
Fear of Being a Guinea Pig/Experiment Subject	
Concerns about bus propulsion system life	
Availability of maintenance training	
Concerns About Safety/New Hazards	
Warranty Inadequacy	
Vehicle Residual Value	
Life Cycle Cost Estimates Will Not be Achieved	
Vehicle Availability	
Liability	

# Infrastructure



Available space for Infrastructure  
*(Early Adopters)*

# Trade Offs