CENTER FOR TRANSPORTATION
AND THE ENVIRONMENT

Low-No Best Practices: From Grant Application to Deployment

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About CTE

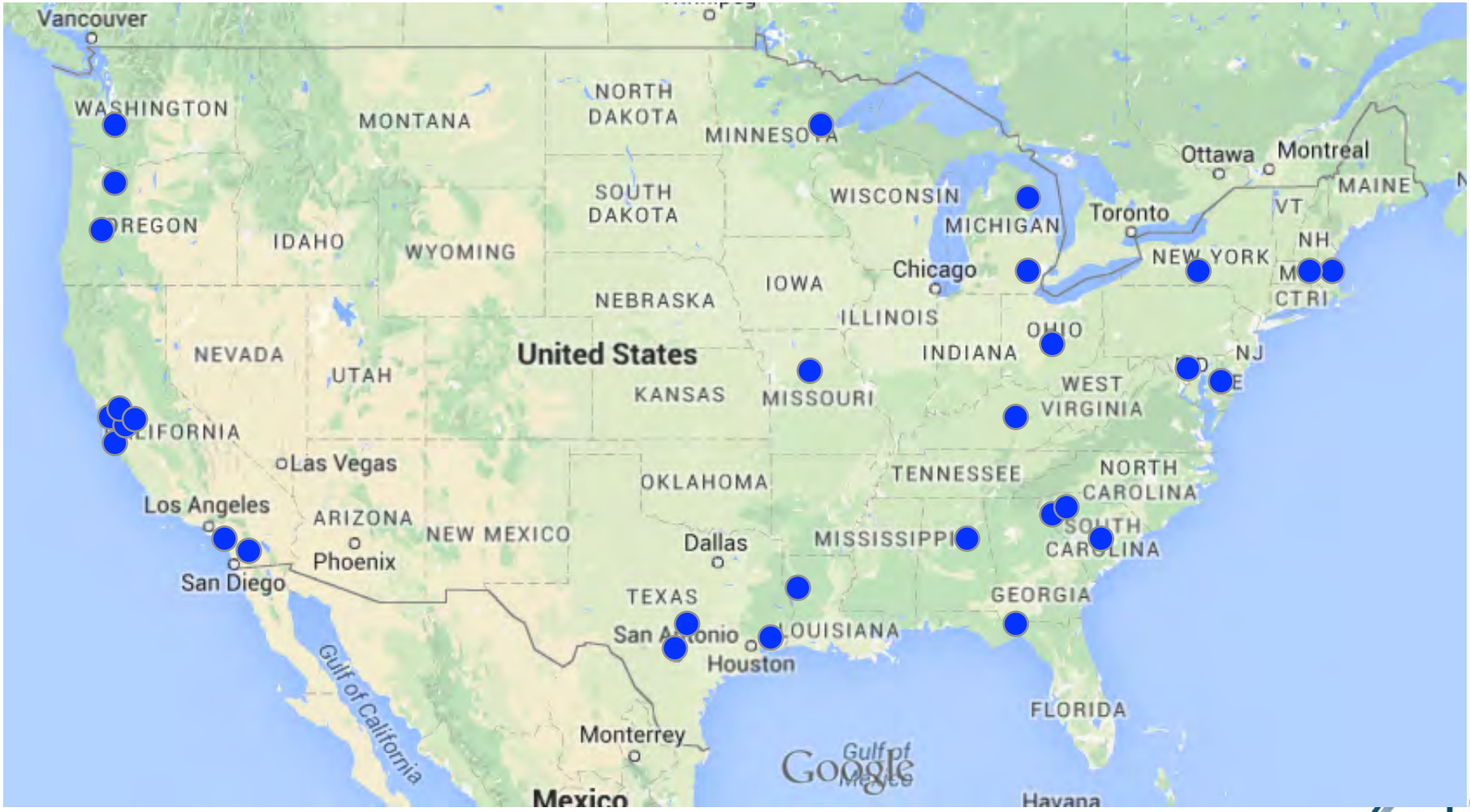
Mission: To advance clean, sustainable, innovative transportation and energy technologies

- Portfolio: $400m+ research, demonstration & deployment
- National presence – Atlanta, Berkley, Los Angeles, St. Paul

Our ZEB Services

- Grant Applications
- Fleet Transition Strategy (a.k.a. ZEB Roadmap)
- Requirements Analysis and Technology Assessment
- Technical Specifications and Procurement Evaluation
- Production Oversight, Buy America Audits, & Resident Inspections
- Deployment Project Management and Technical Assistance
- Benefits Analysis and Key Performance Indicator Reporting

CTE Zero Emission Bus Projects



More than 140 ZEB's with over 30 Transit Agencies!

Keys to ZEB Success

1. Understanding types of ZEB's technologies
2. Understanding ZEB Market & Available Products
3. Understanding ***your*** requirements to determine the best zero emission buses and infrastructure for ***your*** transit agency
4. Understanding FTA's Low-No grants
5. Understanding how to deploy ZEB technologies

ZEB Vendors

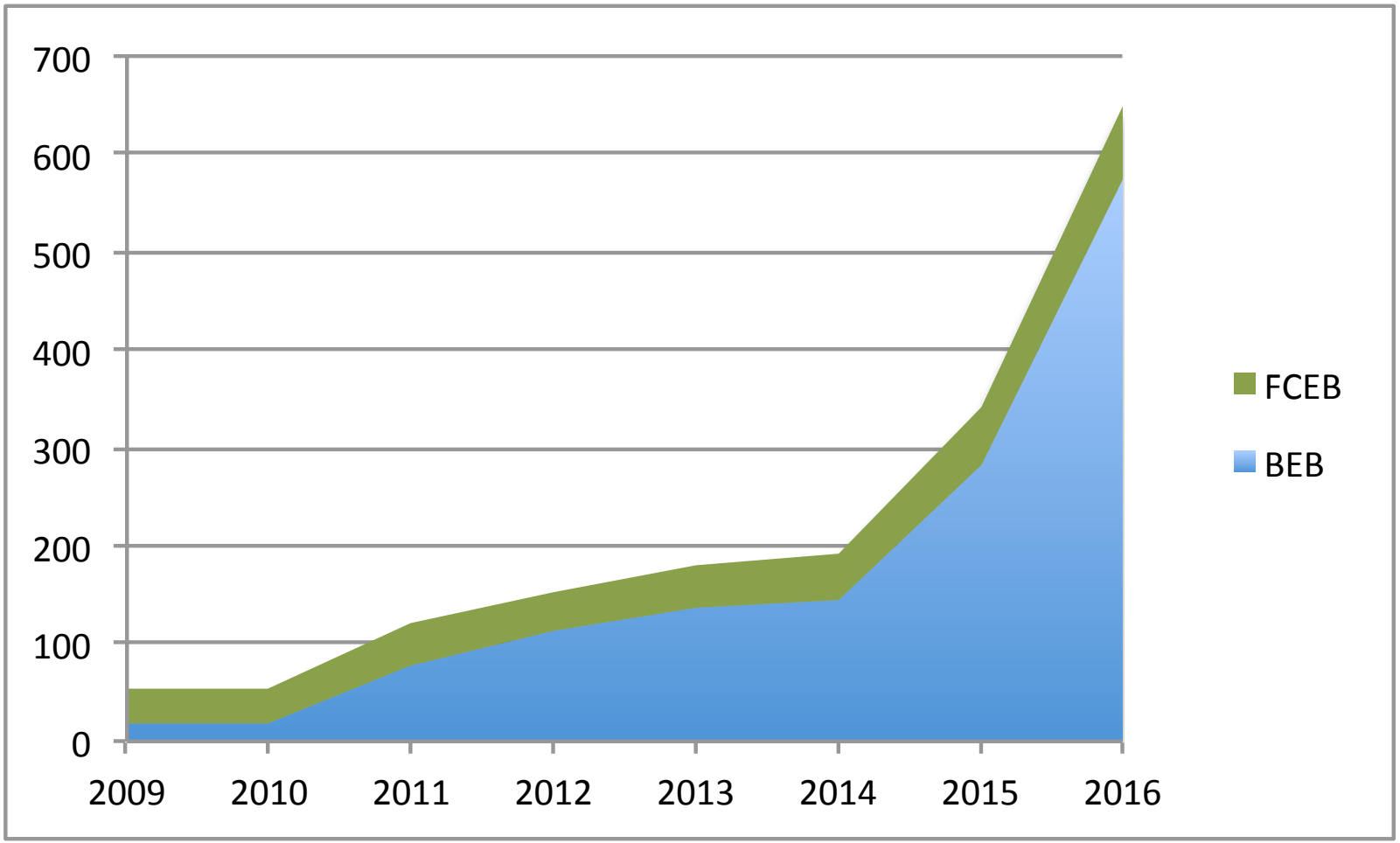
OEM's

- ElDorado National
- BYD
- Complete Coach Works
- Ebus
- Gillig
- GreenPower
- HomeTown Trolley
- New Flyer
- NovaBus
- Phoenix Motors
- Proterra

Integrators, Suppliers

- BAE Systems
- Ballard Power Systems
- Hydrogenics
- Momentum Dynamics
- Siemens
- Unique Electric Solutions
- WAVE
- Linde
- Air Liquide
- ITM Power

ZEB Cumulative Awards/Sales



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Low-No Grant Application Best Practices

Partner Up!

- FTA's Low-No program allows agencies to name and use key partners
  - Bus OEMs
  - Experienced Project Management Consultants
- As a discretionary competitive grant program, meets federal third-party procurement requirements

FTA Goals:

- *Move ZEBs into service as fast as possible*
- *Minimize risk*

Leverage Funding Sources!

- Minimum 15% cost share on buses, 10% on charging infrastructure
- Project management and infrastructure costs can be included in the grant
- Leverage other federal and state sources of funding to reduce requested Low-No amount

FTA Goal: A lower Low-No investment per bus equals more deployed buses

Low-No Best Practice

Commit to Zero Emissions!

- Demonstrated Commitment to Emission Reduction as part of a long range plan
- Project cannot be a “pilot” or “demonstration”

FTA Goal: Technology is commercially proven; looking for agencies ready to make a long-term commitment

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Low-No Deployment Best Practices

Smart Deployment

1. Technology Assessment
2. Infrastructure Planning
3. Deployment Planning
4. Implementation
5. Evaluation (Key Performance Indicators)

Wide Variety of Solutions Available

Bus Manufacturer	Model	Style	Battery Electric or Fuel Cell	Infrastructure	Energy Storage
BYD	K7	30' transit bus	BEB	80 kWDepot Charge	182 kWH
	K9, K9S	40', 35' transit bus	BEB	80 kWDepot Charge	324 kWh
	K11	60'artic. transit bus	BEB	200 kW Depot Charge	547 kWh
	C6, C9, C10	23', 40', 45' coaches	BEB	100-300 kW Depot Charge	135-394 kWh
CCW	ZEPS	40' transit bus	BEB	Depot Charge	213 kWh
Double K	Villager	30' Trolley	BEB	Depot Charge	
Ebus	Ebus	22' city bus	BEB	Depot Charge	
	Ebus	40' transit bus	BEB	On Route Charge	89 kWh
ElDorado/BAE	Axess	40' transit bus	FCB	H2 Station	
Gillig	Standard LF	29' transit bus	BEB	Depot/On Route	100 kWh
Green Power	varies	30'-45'	BEB	Depot Charge	210-478 kWh
New Flyer	Excelsior	40' transit bus	BEB	Depot/On Route	99 kWh
					198 kWh
					297 kWh
			FCB	H2 Station	
		60' transit bus	BEB	Depot/On Route	250 kWh
Nova Bus	LFSe	40' transit bus	BEB	On Route Charge	76 kWh
Proterra	Catalyst FC	40' transit bus	BEB	On Route Charge	79 kWh
					105 kWh
	Catalyst XR	40' transit bus	BEB	Depot/On Route Charge	220 kWh
					330 kWh
	Catalyst E2	40' transit bus	BEB	Depot Charge	440 kWh
					550 kWh
					660 kWh

Step 1: Technology Assessment

Transit agencies need information that allows their personnel to make **data-driven procurement and deployment decisions** regarding electric bus technology.

Explore end-user implementation questions, such as:

1. Which electric-drive technology is the best fit for my route?
2. What are the key differences between electric buses on the market today?
3. How do extreme weather conditions affect bus performance?
4. How do passenger loads affect bus performance?
5. How will driving range change as the batteries age?
6. How often will my bus need to charge? How long will charging take?
7. Should I charge my bus at our depot, or at an on-route location?
8. What happens if I miss a scheduled charge?
9. Which utility rate structure is best suited for my charge strategy?
10. How will electrical utility costs compare to my current fuel costs?
11. What is the total cost of ownership for the different available technologies?

Step 1: Technology Assessment - Key Elements

- Determine most effective use of technology on your routes
  - Bus Modeling & Route Simulation

- Estimate Operating Costs
  - Electricity Rate Modeling & Fuel Cost Analysis

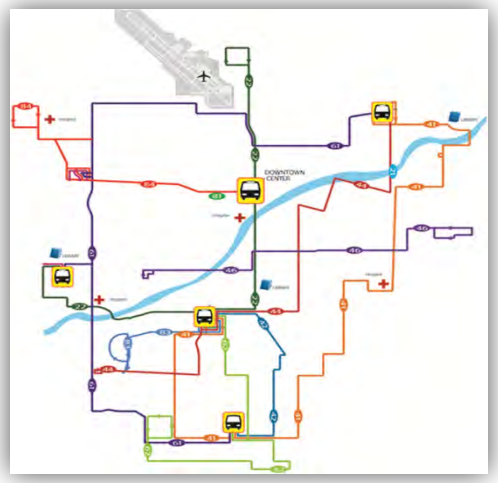
- Establish the Business Case
  - Life Cycle Cost Analysis
  - Risk Assessment

Step 2: Infrastructure Planning

- Location and Layover Planning
- Utility Coordination
- Capacity/Coordination with Vehicle Deployment
- Permitting
- Scalability
- Interface with Existing Infrastructure

Step 3: Deployment Planning

- Employee Training
- Maintenance Training
- First Responder Training
- Route/Service Updates
- PR/Communication
- Data Collection Procedures

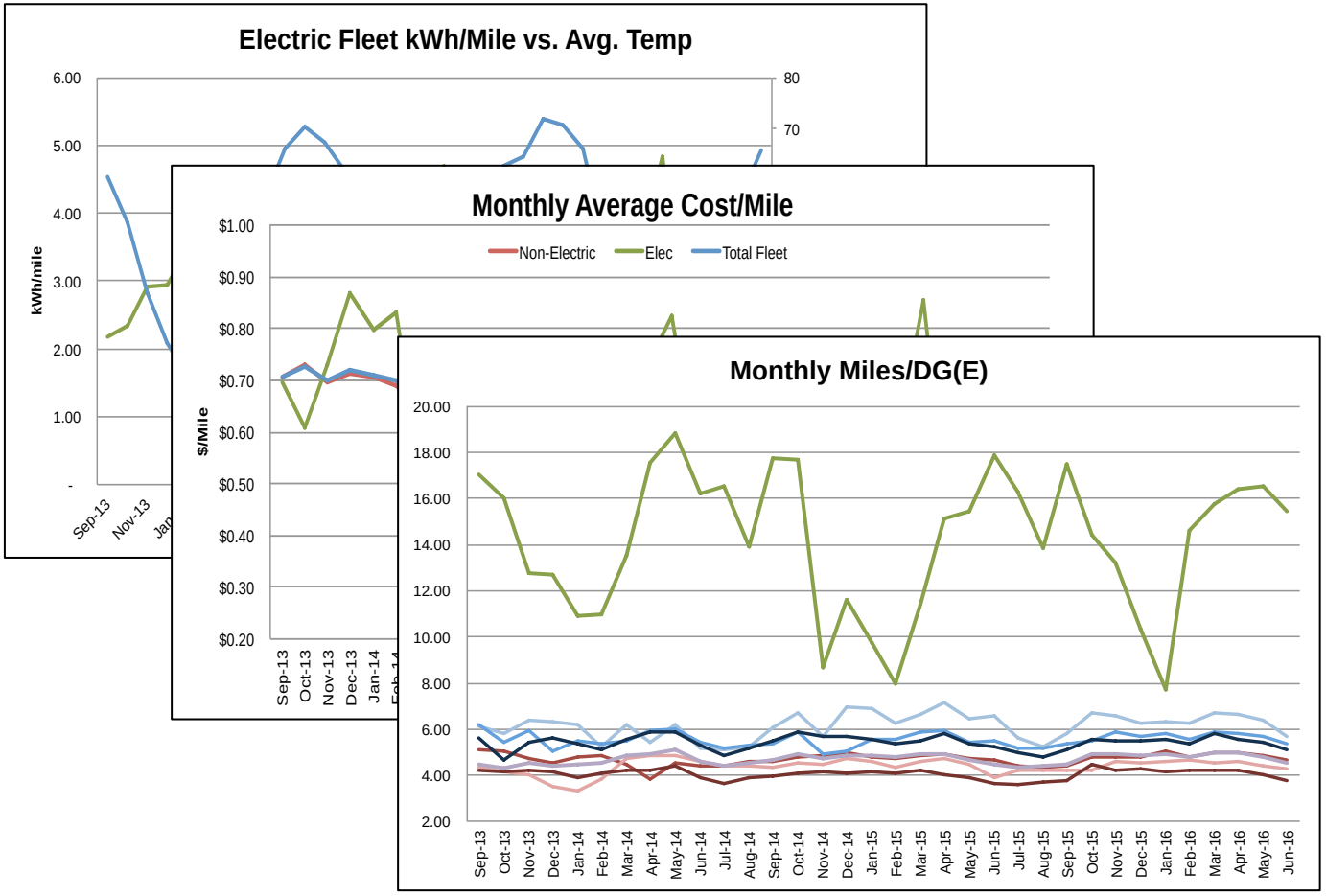


Step 4: Implementation

- Commissioning with Infrastructure
- Shadow service experience with buses
- Adjust deployment strategy, as necessary
- Phased staging of buses into passenger service
  - Provides deployment ‘cushion’ for unforeseen circumstances
- Manage Float/Spare Ratio

Step 5: Key Performance Indicators

Track & Analyze Performance – Take Corrective Action – Realize Benefits – Repeat



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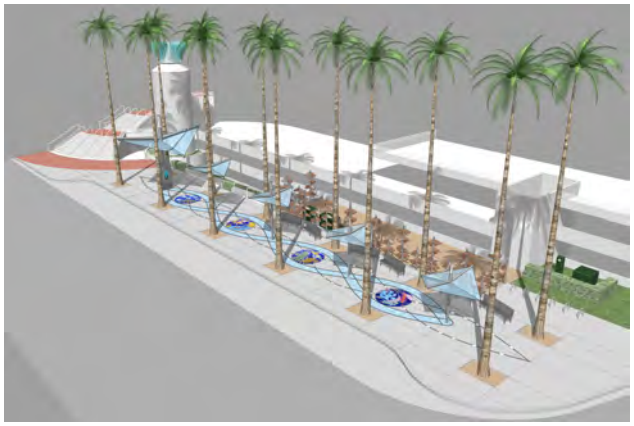
ZEB Panel Discussion



Rolando Cruz

Chief Operations Officer, Big Blue Bus

Formerly

VP of Maintenance and Infrastructure, Long Beach Transit

Rolando Cruz,
Chief Operations Officer

Location:	**Long Beach, CA**
Bus Type:	10 - 40’ Battery Electric BYD Buses with an option for 15 more
Fueling Method:	Depot Charger with on-route Inductive (WAVE) range extender
Grant Program:	2011 - TIGGER grant funded 7 of 10 buses; 1 bus funded by Port of Long Beach 2016 – Low-No award for more buses
Partners:	FTA, Port of Long Beach, CTE, BYD and WAVE

CLEMSON AREA TRANSIT

Al Babinicz

CEO/General Manager
Clemson Area Transit

Al Babinicz

CEO/General Manager

Clemson Area Transit

Location: Clemson, SC

Bus Type: 5 Proterra 35’ and one 40’ Battery Electric;

10 BEBs with option for 28 more (OEM TBD)

Fueling Method: On-Route chargers

Grant Program: Tigger III & Low-No 2016

Partners: FTA, SCDOT, CTE, City of Seneca, and City of Clemson

Alameda-Contra Costa Transit District

Zero Emission Buses

Eve Ng
Senior Capital Planning & Grants Specialist
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Hydrogen Fuel Cell – Present

- Bus Type
  - Thirteen (13) VanHool 40’ Hydrogen Fuel Cell Buses
- Fueling Method
  - Two locations : Emeryville and Oakland
  - Onsite hydrogen production and compression, liquid delivery
- Grant Partners
  - Federal: FTA, DoE NREL
  - State: California Air Resources Board, California Energy Commission, PG&E
  - Local: VTA, SamTrans, Golden Gate Transit
  - OEMs: VanHool, EnerDel, Siemens, US Hybrid (UTC)

Hydrogen Fuel Cell – Future

- Ten 40’ New Flyer hydrogen fuel cell buses in 2018
- Funding sources
  - $4.8 million from California Air Resources Board (CARB) Air Quality Improvement Program Grant
  - $1 million from Bay Area Air Quality Management District
  - District funding
- Part of a consortium – CTE, Orange County Transit Authority, AC Transit, New Flyer, Linde

Battery Electric Buses

- Five new 40-ft battery electric buses in 2018
- Grant Program
  - Awarded $1.55 m in FY2015 FTA LowNo grant to purchase five battery electric buses and charging equipment.
- Project partners
  - CTE and New Flyer

Rashidi Barnes

Sr. Manager of Transportation,
County Connection (CCCTA)

Rashidi Barnes, Sr. Manager of Transportation CCCTA

Location: Central Contra Costa County

Bus Type: Electric Gillig LF 29’ Trolley (4);
Electric Gillig 29’ Transit Buses (4)

Fueling Method: Fully Electric with On-Route Wireless Charging

Grant Programs: 1st FY12 FTA Clean Fuels;
2nd FTA FY16 Low-No Program

Partners: Gillig, BAE Systems, CTE, WAVE & BART

Conclusions

- ZEBs are here, market is growing
- Technology Assessment is the key to evaluating options
- Differences in climate, topography, routes, and utility rates create different opportunities for different agencies
- Low-No is a great avenue to start transitioning your fleet to zero emission

Questions for All of Today's Presenters?

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