Low-No Best Practices:
From Grant Application to Deployment

Steve Clermont, Director, Senior Project Manager
Jason Hanlin, Director of Technology Development

February 1, 2017
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
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
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
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
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

<table>
<thead>
<tr>
<th>Bus Manufacturer</th>
<th>Model</th>
<th>Style</th>
<th>Battery Electric or Fuel Cell</th>
<th>Infrastructure</th>
<th>Energy Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BYD</strong></td>
<td>K7</td>
<td>30' transit bus</td>
<td>BEB</td>
<td>80 kWDepot Charge</td>
<td>182 kWh</td>
</tr>
<tr>
<td></td>
<td>K9, K9S</td>
<td>40', 35' transit bus</td>
<td>BEB</td>
<td>80 kWDepot Charge</td>
<td>324 kWh</td>
</tr>
<tr>
<td></td>
<td>K11</td>
<td>60'artic. transit bus</td>
<td>BEB</td>
<td>200 kW Depot Charge</td>
<td>547 kWh</td>
</tr>
<tr>
<td></td>
<td>C6, C9, C10</td>
<td>23', 40', 45' coaches</td>
<td>BEB</td>
<td>100-300 kW Depot Charge</td>
<td>135-394 kWh</td>
</tr>
<tr>
<td><strong>CCW</strong></td>
<td>ZEPS</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>Depot Charge</td>
<td>213 kWh</td>
</tr>
<tr>
<td><strong>Double K</strong></td>
<td>Villager</td>
<td>30' Trolley</td>
<td>BEB</td>
<td>Depot Charge</td>
<td></td>
</tr>
<tr>
<td><strong>Ebus</strong></td>
<td>Ebus</td>
<td>22' city bus</td>
<td>BEB</td>
<td>Depot Charge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ebus</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>On Route Charge</td>
<td>89 kWh</td>
</tr>
<tr>
<td><strong>ElDorado/BAE</strong></td>
<td>Axess</td>
<td>40' transit bus</td>
<td>FCB</td>
<td>H2 Station</td>
<td>100 kWh</td>
</tr>
<tr>
<td><strong>Gillig</strong></td>
<td>Standard LF</td>
<td>29' transit bus</td>
<td>BEB</td>
<td>Depot/On Route</td>
<td>210-478 kWh</td>
</tr>
<tr>
<td><strong>Green Power</strong></td>
<td>varies</td>
<td>30'-45'</td>
<td>BEB</td>
<td>Depot Charge</td>
<td></td>
</tr>
<tr>
<td><strong>New Flyer</strong></td>
<td>Excelsior</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>Depot/On Route</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FCB</td>
<td>H2 Station</td>
<td>297 kWh</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60' transit bus</td>
<td>BEB</td>
<td>Depot/On Route</td>
<td>250 kWh</td>
</tr>
<tr>
<td><strong>Nova Bus</strong></td>
<td>LFSe</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>On Route Charge</td>
<td>76 kWh</td>
</tr>
<tr>
<td><strong>Proterra</strong></td>
<td>Catalyst FC</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>On Route Charge</td>
<td>79 kWh</td>
</tr>
<tr>
<td></td>
<td>Catalyst XR</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>Depot/On Route Charge</td>
<td>220 kWh</td>
</tr>
<tr>
<td></td>
<td>Catalyst E2</td>
<td>40' transit bus</td>
<td>BEB</td>
<td>Depot Charge</td>
<td>550 kWh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>660 kWh</td>
</tr>
</tbody>
</table>
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
ZEB Panel Discussion
Rolando Cruz
Chief Operations Officer, Big Blue Bus
Formerly
VP of Maintenance and Infrastructure, Long Beach Transit
### Location:
**Long Beach, CA**

<table>
<thead>
<tr>
<th>Bus Type:</th>
<th>10 - 40’ Battery Electric BYD Buses with an option for 15 more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fueling Method:</td>
<td>Depot Charger with on-route Inductive (WAVE) range extender</td>
</tr>
<tr>
<td>Grant Program:</td>
<td>2011 - TIGGER grant funded 7 of 10 buses; 1 bus funded by Port of Long Beach 2016 – Low-No award for more buses</td>
</tr>
<tr>
<td>Partners:</td>
<td>FTA, Port of Long Beach, CTE, BYD and WAVE</td>
</tr>
</tbody>
</table>
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
eng@actransit.org
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)
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?

To contact CTE: [www.cte.tv](http://www.cte.tv)

**Steve Clermont**

[steve@cte.tv](mailto:steve@cte.tv)

**Jason Hanlin**

[jason@cte.tv](mailto:jason@cte.tv)