A Zero Emissions Fleet Transformation Starts at the Top

Presented by Craig Cipriano | National Director of Zero Emissions Mobility at STV
Craig Cipriano

- 34 years of public transit experience
- National Director of Zero Emissions (ZE) Mobility at STV Incorporated
- Past President of MTA Bus Company
  - Led transition to 100% ZE fleet by 2040
MTA BEB DEPLOYMENT

Lessons Learned

- High energy consumption in cold weather limits range
- Bus reliability shows need for technology maturation
- On-street charger construction complicated, costly + slow
Challenges

- Major infrastructure construction on a tight timeline
- Current battery range insufficient for many bus schedules
- Limited number of qualified vendors + bus models
- New power demand equivalent to a small city
- Charger installation in space-constrained depots
- Continued operation during power outages
STV’s ZE Transformation Experience

- Zero emission master planning
- Vehicle procurement support
  - Technical specifications
  - In-plant + QA inspections
  - Acceptance testing
- Facilities + infrastructure

- Zero emission fleet transition master plan
- 2,400 buses + 1,000 paratransit vans
- Fixed-route + on-demand service

- ZEB program master plan
- Procurement of 2,100 BEBs + chargers
  - BEB technical specifications

- New maintenance facility for 272 buses
  - Services diesel + electric buses
  - Design-build delivery
Zero Emission Ecosystem
Zero Emission Ecosystem

- Addresses technical complexity
- Facilitates organizational change management
- Helps deliver equitable + resilient ZE transformation
Principles
ZE Master Plans

Roadmap for ZE transition
- Methods to identify, procure + deploy zero emission fleets

Key elements
- Safety assessment
- Resilience analysis
- Equity/Environmental justice analysis
- Operation plan analysis - modeling
- Fleet + facilities analysis
- Energy sourcing + power analysis
- Financial analysis
- Provisioning
- Technology opportunities
- O+M support

ZEB transition plan
Systemwide analysis of power needs
Funding support/grant writing

Fleet replacement + facility electrification master plans
5 transit agencies in upstate NY + suburban NYC

ZEB transition master plan, Project Zero
Roadmap for fleet replacement + facility electrification
PEER Tool + Energy Modeling

- ZEB bus route energy analysis + consumption tool
  - Simulates each schedule block to determine energy consumption
    - Determines if available battery sufficient to complete each schedule block
- Battery life simulations
  - Estimates impact of future battery energy levels
- Creates roadmap for network redesign

### SAMPLE PEER ELECTRIC BUS OPERATIONS ANALYSIS

<table>
<thead>
<tr>
<th>WEEKDAY DRIVER BLOCK SUMMARY</th>
<th>DRIVER BLOCK</th>
<th>ROUTES DRIVEN</th>
<th>TIME FRAME</th>
<th>TOTAL DURATION</th>
<th>TOTAL MILES</th>
<th>TOTAL ENERGY REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>176457</td>
<td>18443, 18444</td>
<td>6:24am-8:35am</td>
<td>2:11 hours</td>
<td>95.95 mi.</td>
<td>125.21 kWh</td>
<td></td>
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<tr>
<td>176458</td>
<td>18443, 18444</td>
<td>6:28am-9:04am</td>
<td>2:36 hours</td>
<td>100.79 mi.</td>
<td>144.02 kWh</td>
<td></td>
</tr>
<tr>
<td>176459</td>
<td>18443, 18455</td>
<td>6:50am-9:16am</td>
<td>2:26 hours</td>
<td>123.63 mi.</td>
<td>187.65 kWh</td>
<td></td>
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<tr>
<td>176461</td>
<td>18443, 18474, 18483</td>
<td>6:49am-8:42pm</td>
<td>13:53 hours</td>
<td>109.74 mi.</td>
<td>272.77 kWh</td>
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<tr>
<td>176490</td>
<td>18443, 18444</td>
<td>2:30pm-12:05am</td>
<td>9:35 hours</td>
<td>106.35 mi.</td>
<td>469.39 kWh</td>
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<tr>
<td>176463</td>
<td>18444, 18443</td>
<td>6:04am-7:53am</td>
<td>1:49 hours</td>
<td>98.31 mi.</td>
<td>174.59 kWh</td>
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<tr>
<td>176464</td>
<td>18444, 18443</td>
<td>6:47am-8:53am</td>
<td>2:06 hours</td>
<td>98.31 mi.</td>
<td>150.44 kWh</td>
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<tr>
<td>176701</td>
<td>18456</td>
<td>5:57am-2:59pm</td>
<td>9:02 hours</td>
<td>150.53 mi.</td>
<td>406.15 kWh</td>
<td></td>
</tr>
<tr>
<td>176466</td>
<td>18443, 18444</td>
<td>7:09am-9:44am</td>
<td>2:35 hours</td>
<td>100.79 mi.</td>
<td>119.76 kWh</td>
<td></td>
</tr>
</tbody>
</table>

- Presumes a standard battery on a 40-ft BEB has 414 “usable” kWh of energy

**KEY:**
- **GREEN:** Can operate on existing schedule
- **YELLOW:** Possibly operate on existing schedule
- **RED:** Requires route restructure or on-route charging
GETTING TO 100%

10 vs. 100 vehicle dilemma

- Needs of a full ZE fleet vastly different from needs during a pilot program
- Complexity + expense of installing charging infrastructure becoming clear
- Ability to get the amount of electricity needed from power company
Enablers
PMO Structure

- Program management plan
  - Coordinated approach
  - Demonstrated leadership commitment

- Three-pronged approach
  - Program Office
  - Working Groups
  - Steering Meetings
Change Management

- Implement change management process from the top
  - Prioritize driving change from organizational + workforce level

- Organizational change management
  - Safety awareness
  - Resiliency
  - Route redesign plans
  - Training

- Workforce development + change management
  - Engage employees from the onset
  - Upskill employees to advanced systems
  - Training program, including safety training
Pathways
Vehicles

- Vehicle design — track evolving marketplace
- Battery design/safety consideration
- Fleet replacement plan
- Fleet management
Facilities

- Retrofitting legacy depots
  - Significant space constraints
  - Ceiling height for pantographs big issue
  - Large footprint of charging + power infrastructure

- Designing new purpose-built depots
Power

► Power supply limitations

► Large power demand to charge ZE fleet

► Power resilience

► Engage early with power suppliers + utility regulators
  • Suppliers: install new capacity, negotiate rates
  • Regulators: charger installation
Funding

- Federal funding for ZE transformations
  - Discretionary programs
    - USDOT RAISE, INFRA, SMART
    - FTA Low-No, Bus/Bus Facilities, AIM
    - DOE/EPA grants
  - Innovative finance programs
    - State DOT infrastructure bank
    - USDOT TIFIA
- Energy as a Service (EaaS)
Thank you

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