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 BATTERY ELECTRIC BUS DEPLOYMENT (2017-2025):

2017-2018
PILOT PROGRAM
START
5 PROTERRA BUSES
5 NEW FLYER BUSES

2020
FIRST PURCHASE
15 NEW FLYER ARTICS

2020
FUNDING COMMITMENT
$1.1 BILLION IN 2020-2024 CAPITAL PLAN
475 ELECTRIC BUSES BY 2024
10 BUS DEPOTS (EV INFRASTRUCTURE)

2021
CHARGER INSTALLATION
21 IN-DEPOT CHARGERS
3 ON-STREET CHARGERS

2023-2025
NEXT DEPLOYMENT
500 BATTERY ELECTRIC BUSES

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 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

Performance + Evaluation of Electric bus Routes (PEER)

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

WEEKDAY DRIVER BLOCK SUMMARY

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

- 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%

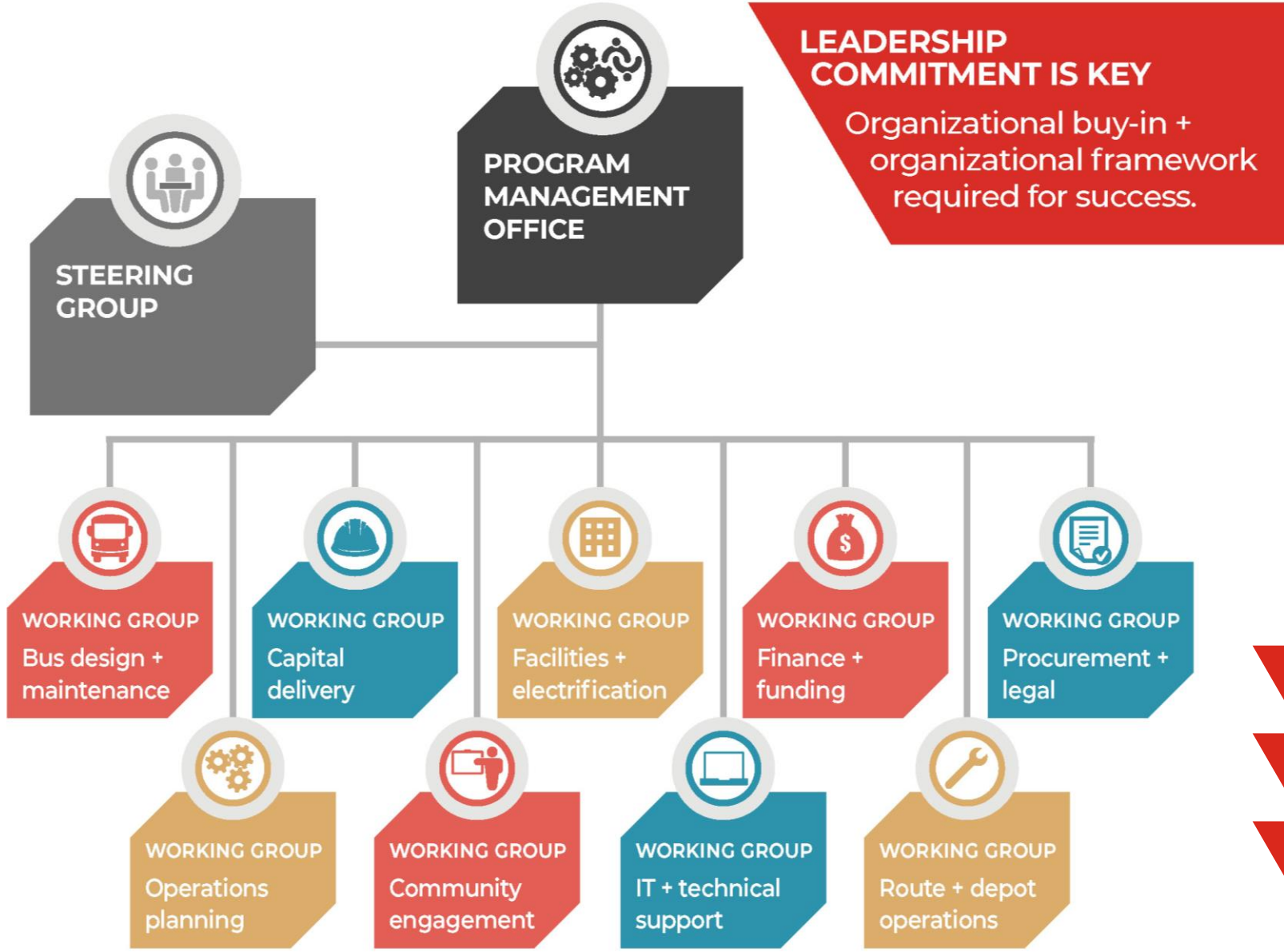
10 vs. 100 vehicle dilemma

- 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

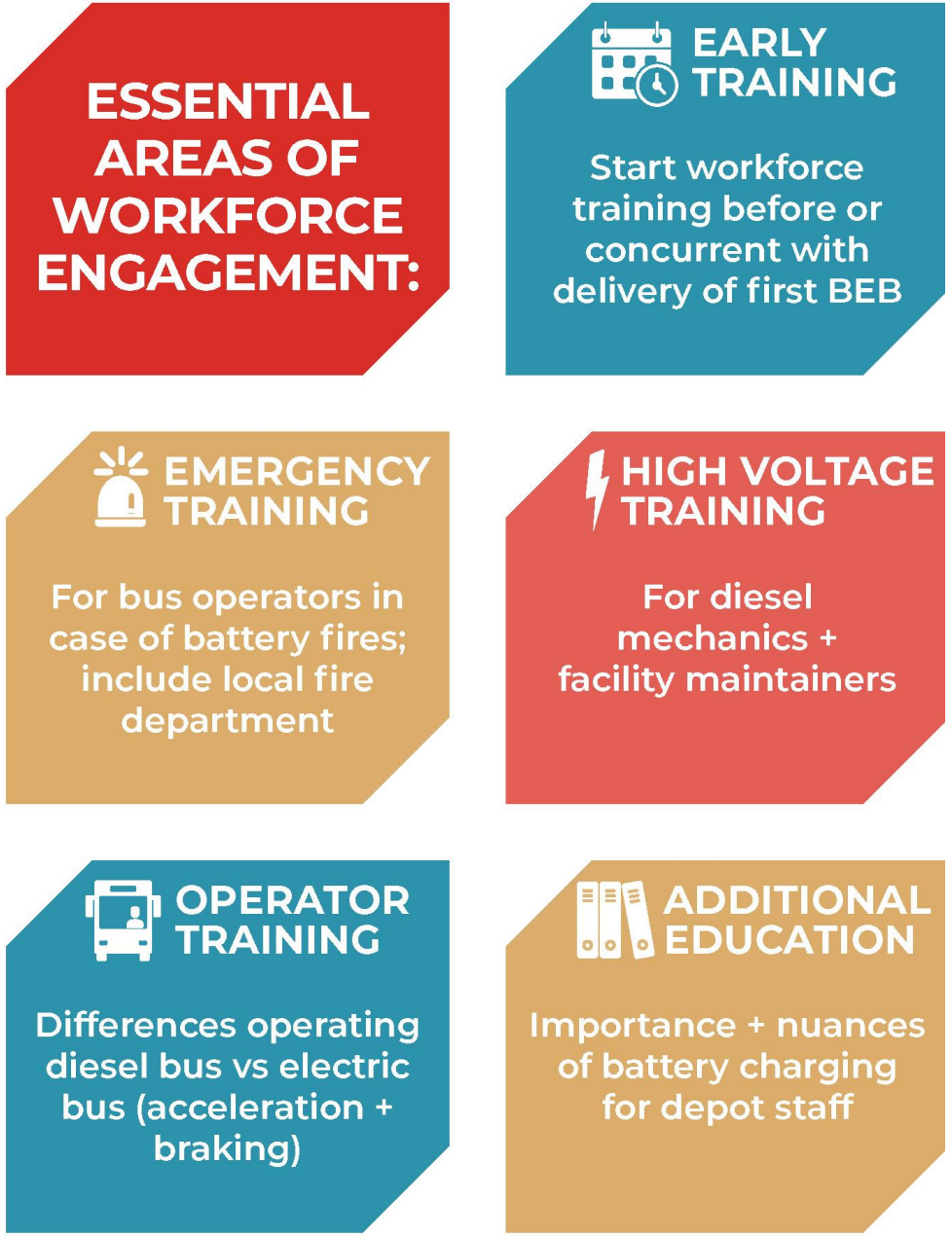
PMO Structure

- 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

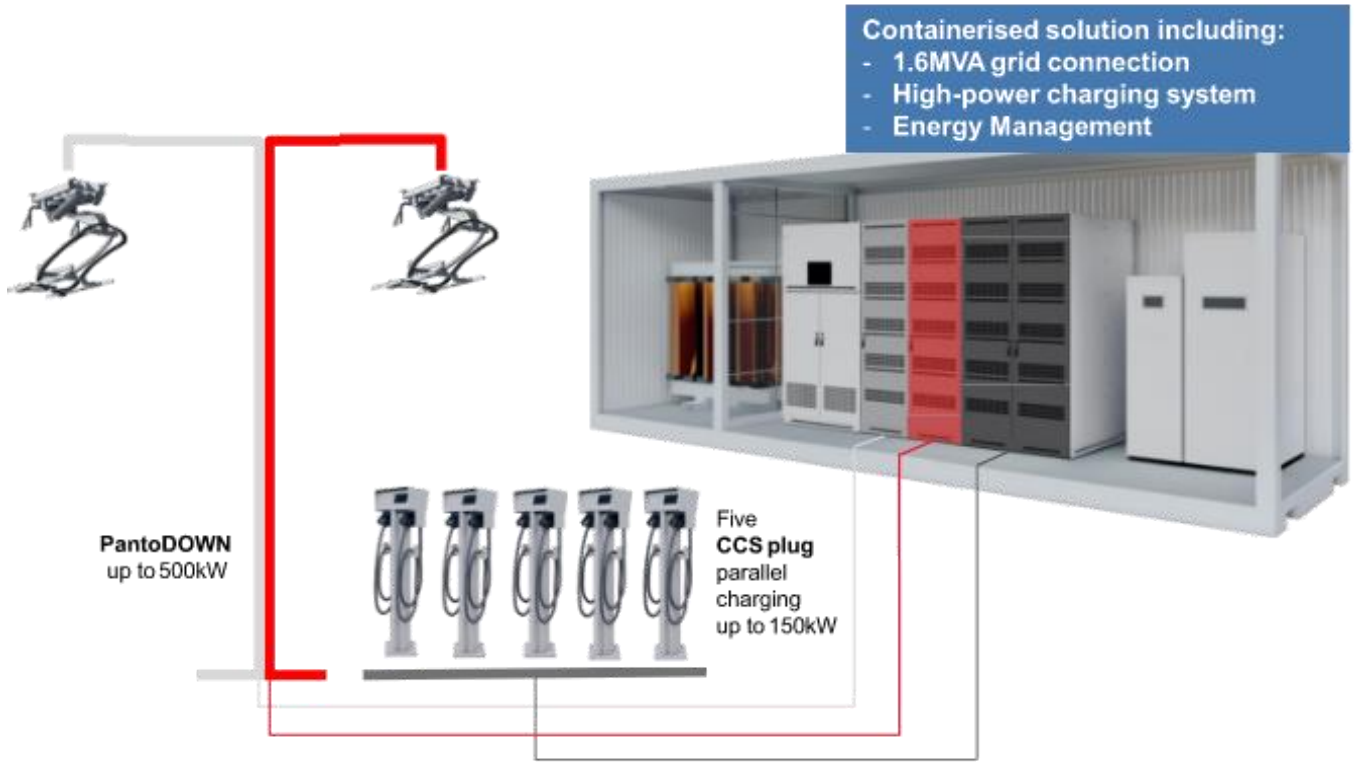
- Vehicle design — track evolving marketplace
- Battery design/safety consideration
- Fleet replacement plan
- Fleet management

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)

STV has helped secure more than $2.8 billion in transportation grants

Thank you

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