SEPTA at a Glance

- Multimodal “Legacy System”
- Created by PA State Legislature in 1964
- Philadelphia Region (Five Counties)
- 6th Largest in U.S.
- 1 Million Daily Riders (300 Million Annually)
- 2,800 Vehicles
- 9,500 Employees
- $1.4B Operating Budget
- $675M Capital Budget
Award-Winning Sustainability Program

“BUDGET-NEUTRAL” PRINCIPLE FOR IMPLEMENTATION

ENERGY STORAGE

ROOFTOP SOLAR POWER

UTILITY-SCALE SOLAR POWER

BATTERY-ELECTRIC BUSES
Bus Fleet Technology Trend

- **CURRENT FLEET**
- **COMMOTTED FLEET**
- **DIESEL**
- **HYBRID**
- **ZERO EMISSION**
History of Zero Emission Buses @ SEPTA

- **2007:** 38 Trolley Buses (“Trackless Trolleys”) Procured
- **2012:** Fleet Technology Evaluation in Favor of Hybrid-Electric (& Potential of BEB)
- **2016:** FTA LoNo Grant Received for 25 Battery-Electric Buses (BEB) (Vendor: Proterra)
- **2017:** Change Order to Proterra for “Extended Range” Buses
- **2018 (Spring):** BEB Depot Charging Infrastructure Installed
- **2018 (Summer):** FTA LoNo Grant Received for 10 BEB (Vendor: New Flyer)
- **2018 (Fall):** BEB Readiness Planning Initiated with PECO + SEPTA Engineering, Facilities, Service Planning, Finance, Operations, Innovation
- **2019 (Summer):** Proterra Buses Delivered & Enter Revenue Operation
Why Battery-Electric Buses?

TRIPLE-BOTTOM-LINE BENEFITS

- **ENVIRONMENTAL:** Lower Greenhouse Gas (GHG) Emissions – A Climate Change Solution
- **SOCIAL:** Zero Tailpipe Emissions & Quieter Operation in Neighborhoods – An Equitable Solution
- **ECONOMIC:** Lower Operating (Fuel & Maintenance) Costs – A Financial Solution
Approach to Initial Deployment

- Large Enough Deployment (25) to Fully Understand Scalability Challenges
- Extended Range Buses with In-District Overnight Slow (50 kW) Charging
- Dedicated to Routes that are Short (3.5 miles), Flat & Close to the District
- Beginning Weekend Runs on Longer Routes to Test Range Capabilities
Key Challenges Encountered To-Date

- **1) COST:** Higher Upfront Cost of Vehicles & Net New Cost of Charging Infrastructure

- **2) ELECTRICAL SUPPLY:** Limited Capacity, No Redundancy of Grid Feeds into District & Issues with Utility Tariff Structure

- **3) DISTRICT OPERATIONS & LOGISTICS:** Limited Space for Chargers, Implications of Dedicated Parking Spots, Scheduling Constraints

NEW SUBSTATION REQUIRED FOR POWER CAPACITY
Key Challenges Encountered To-Date

4) VEHICLE MAINTENANCE & PERFORMANCE: Weight of Buses Leading to Ride Quality Issues, Uncertain Range Limitations in Extreme Weather, Fleet Size/Spare Ratio Requirements

5) DATA & IT SYSTEMS: Acquiring Performance Data, Lack of System Integration Between Bus/Chargers, Limitations on “Smart Charging”

6) MANAGING EXPECTATIONS: SEPTA Replaces Approximately 100 Buses Per Year, Full Fleet Over a 15-year Lifecycle

BUS PERFORMANCE SUMMARY AUGUST & SEPTEMBER 2019

<table>
<thead>
<tr>
<th>Week of Date</th>
<th>kWh per Mi</th>
<th>Implied Range (Mi)</th>
<th>MPGe</th>
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<tbody>
<tr>
<td>July 28, 2019</td>
<td>2.65</td>
<td>133.3</td>
<td>14.34</td>
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<td>August 4, 2019</td>
<td>2.73</td>
<td>132.5</td>
<td>14.25</td>
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<td>August 11, 2019</td>
<td>2.62</td>
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<td>August 18, 2019</td>
<td>2.67</td>
<td>133.7</td>
<td>14.39</td>
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<td>August 25, 2019</td>
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<td>142.0</td>
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<td>September 1, 2019</td>
<td>2.58</td>
<td>143.0</td>
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<td>September 8, 2019</td>
<td>2.57</td>
<td>139.4</td>
<td>15.00</td>
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<td>September 15, 2019</td>
<td>2.50</td>
<td>141.8</td>
<td>15.25</td>
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<tr>
<td>September 22, 2019</td>
<td>2.51</td>
<td>141.7</td>
<td>15.24</td>
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<td>September 29, 2019</td>
<td>2.57</td>
<td>138.9</td>
<td>14.94</td>
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VS. HYBRID-ELECTRIC MPG: ~3.50-4.00
Next Steps

- **CONTINUE READINESS MASTER PLANNING:** Focus on Scalability of Charging Infrastructure, with Innovative Alternatives

- **EVALUATE WINTER PERFORMANCE:** Peers Are Reporting Significant Range Reduction

- **COORDINATE WITH ELECTRIC UTILITY:** Who Pays for Supply Infrastructure? How Will We Ensure it is Resilient?

- **DETERMINE FUTURE PROCUREMENT STRATEGY:** How/When to Integrate BEBs at Scale? Bus Must Be Able to Last 15 Years

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<table>
<thead>
<tr>
<th>DEPOT</th>
<th># OF BUSES</th>
<th>SPARE ELECTRIC CAPACITY (MW)</th>
<th>BEB CAPACITY NOW</th>
<th>ADDED MW CAPACITY NEEDED FOR FLEET CONVERSION</th>
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<tr>
<td>ALLEGHENY</td>
<td>123</td>
<td>1.5</td>
<td>12</td>
<td>6.7</td>
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<tr>
<td>CALLOWHILL</td>
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<td>1.5</td>
<td>13</td>
<td>11.3</td>
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<td>COMLY</td>
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<td>9</td>
<td>10.0</td>
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<td>FRANKFORD</td>
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<td>0.7</td>
<td>4</td>
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<td>1.5</td>
<td>18</td>
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<tr>
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<td>11.7</td>
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<td>1.0</td>
<td>5</td>
<td>8.3</td>
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<td><strong>TOTAL</strong></td>
<td><strong>1499</strong></td>
<td><strong>14.0 MW</strong></td>
<td><strong>105 BEB</strong></td>
<td><strong>80.4 MW</strong></td>
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Key Takeaway: Let’s Walk Before We Run

THIS...

...BEFORE THIS