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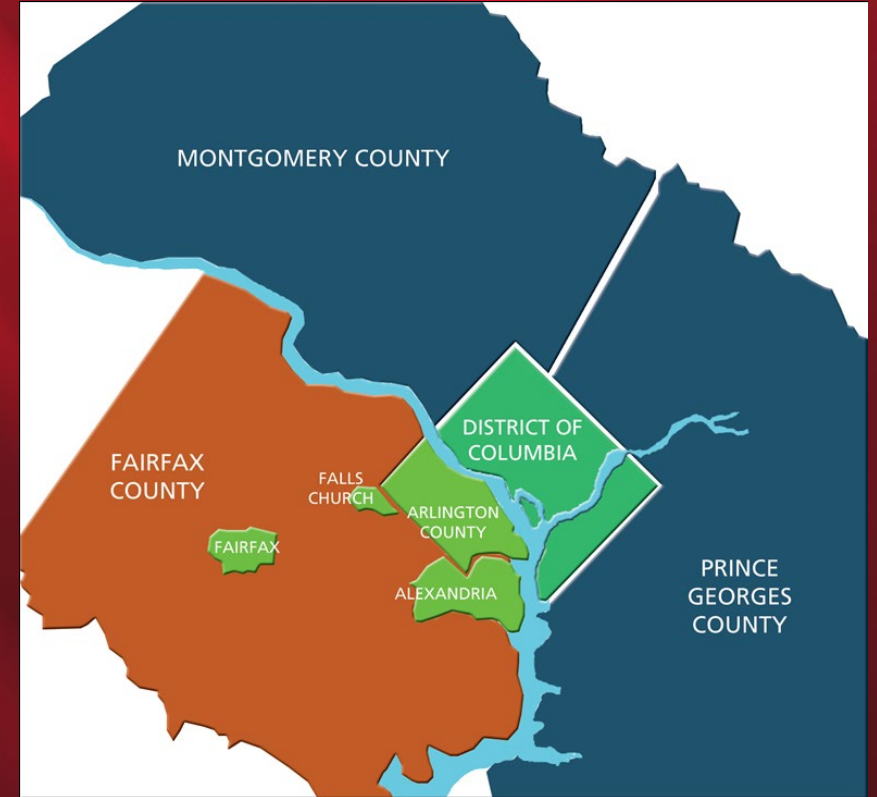
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Washington Metropolitan Area Transit Authority (WMATA)

- The Metrorail system is the second busiest in the United States providing transit service for more than 600,000 customers a day throughout the Washington, DC area
- Metrobus is the sixth busiest bus agency in the United States providing over 400,000 trips each weekday to a population of 3.9 million within the 1,500 square miles of Metrobus service area



Steps WMATA has Taken

- WMATA has recently concluded a assessment of electric vehicle technology for the service area
- In 2020, WMATA will begin preparations for a two-year focused test and evaluation of how different manufacturers electric bus and charging technologies can form a large scale zero emissions fleet to serve the region
- Re-construction of two bus facilities that will be “electric bus ready”. These facilities will phase in Metro’s future transition into zero-emission fleet technology

Not Just the Bus

- Substantial new electric infrastructure requirements at bus garages
- Electric bus utility rates are not yet defined locally
- New skills and transition plan required for the workforce
- Parts, procurement and maintenance processes must adapt
- Must consider route planning and technology options



PRIMARY BENEFITS



REDUCED FUEL COSTS;
LESS DEPENDENCY ON
FOSSIL FUELS



FEWER GREENHOUSE
GASES, NO_x EMISSIONS;
& PARTICULATE MATTER



QUIETER VEHICLES;
LESS VIBRATION;
GREATER COMFORT



REDUCED
OPERATIONS &
MAINTENANCE COSTS



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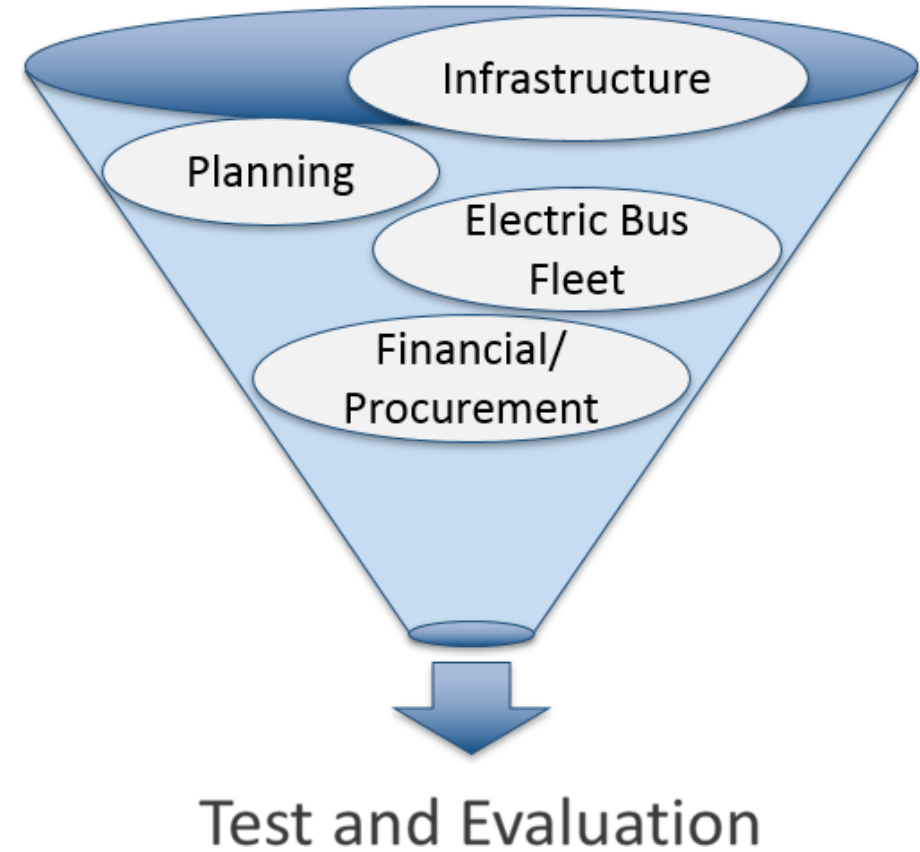
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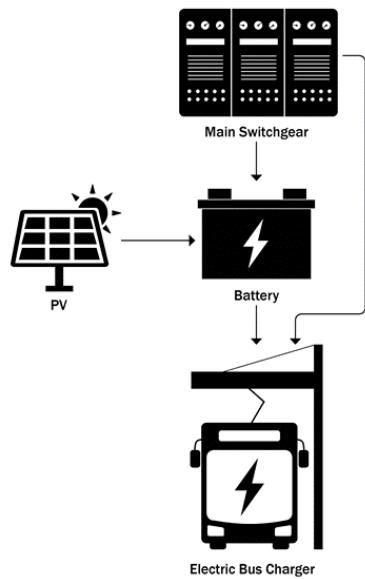
Assessment Goals

- Infrastructure
 - Case Studies
 - Energy needs, charging infrastructure
- Planning
 - Facility and route selection
- Electric Bus Fleet
 - Assessment and modeling
- Financial
 - Cost analysis

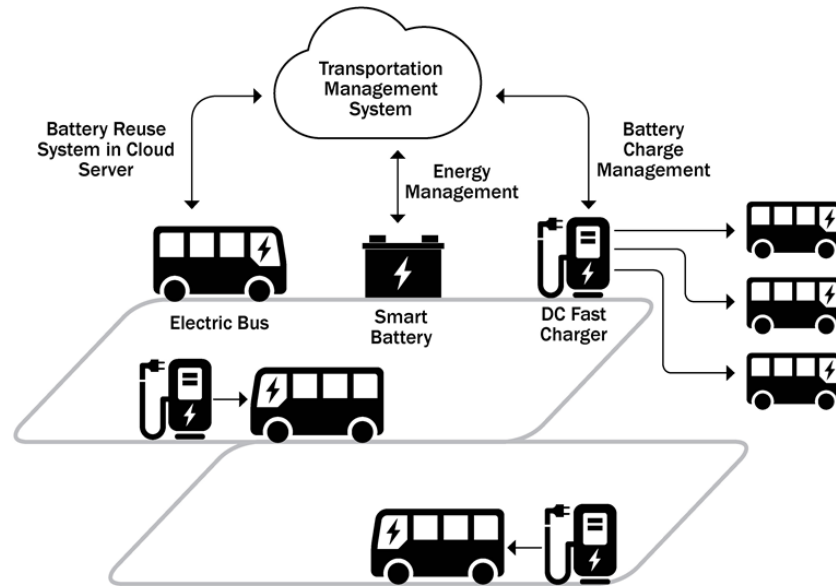


Energy Impacts and Requirements

- Full deployment of electric buses will put a large amount of stress on the utility grid
- WMATA can employ technologies to mitigate the risk potential associated with charging electric buses at Metrobus facilities



Smart Charging



Battery Energy Storage



Microgrids



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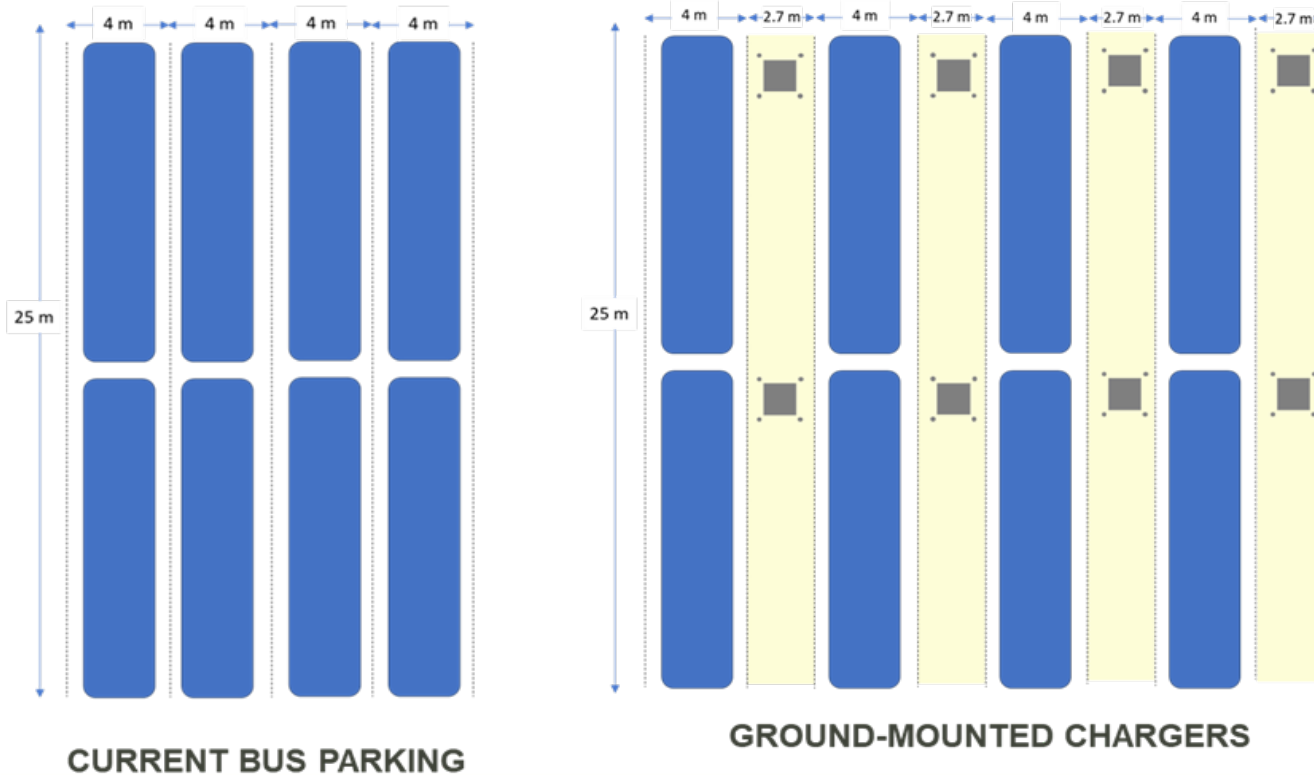
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Facility Capacity

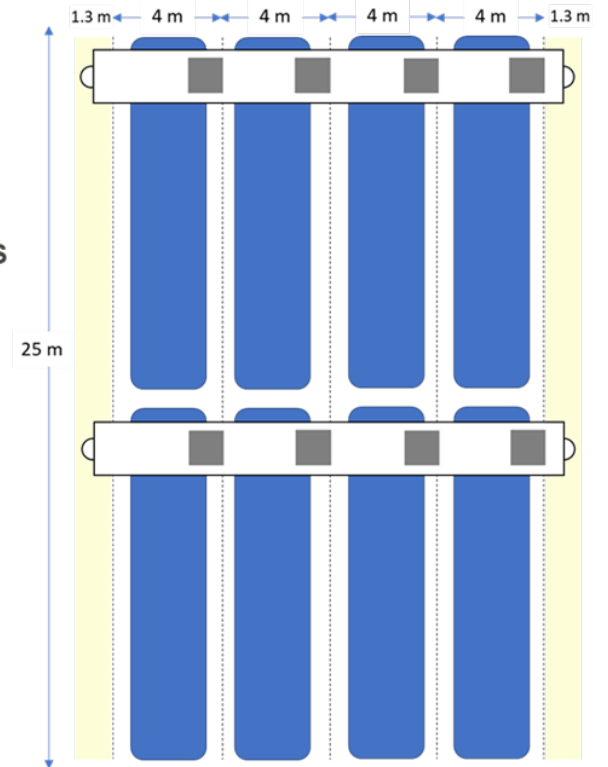
- Ground mounted chargers will reduce parking capacity approximately 40%
- Overhead chargers will reduce parking capacity less than 10%



OVERHEAD CHARGERS

~55 m²/12-m bus
not including circulation space

As little as 10% loss in parking capacity for full depot conversion.



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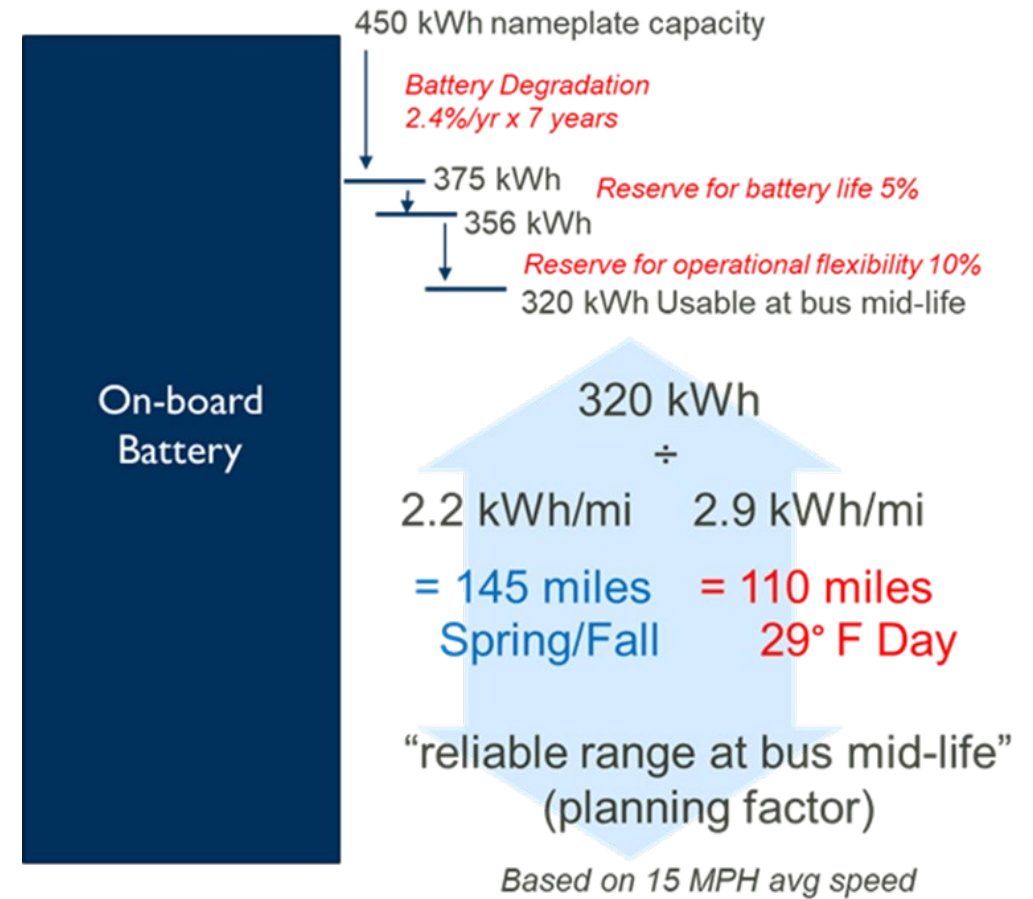
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Route Planning

- 90 percent of existing routes can be operated with a standard-sized electric bus battery without any changes to the schedule
- The remaining 10 percent would need to recharge at the depot during midday, do opportunity charging at a layover location, or have its schedule changed



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Bus Charging Alternatives and Impacts

Charging Alternative	Charging Locations & Times of Day	Schedule Impacts	Estimated Increase of Buses Required
Overnight charging, depot only	At divisions overnight	Would need to break up blocks that are too long	533
Overnight + daytime depot charging only	At divisions at all times	Would need to break up blocks that are too long	69
Overnight and in-route charging	At divisions overnight and in-route at all hours	May have to lengthen layover times to allow for charging	0
Overnight, daytime, and in-route charging	At divisions and in-route locations at all times	No impact	0
In-route charging only	All times at in-route locations	Would have to lengthen layover times to allow for charging	115



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Bus Charging Requirements

■ Depot Charging

- Lower infrastructure costs
- Potentially lower electricity
- Limited bus range



■ In-Route Charging

- No limitation on daily bus range
- No loss of depot parking capacity
- Potentially higher electricity costs
- Higher infrastructure costs
- Must add time to existing schedules



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Financial Considerations

- Operating costs will fall with the adoption of electric buses
- Additional capital funding is required due to the higher vehicle and infrastructure costs
- The emissions savings are significant
- An equitable electric rate structure must be developed

