

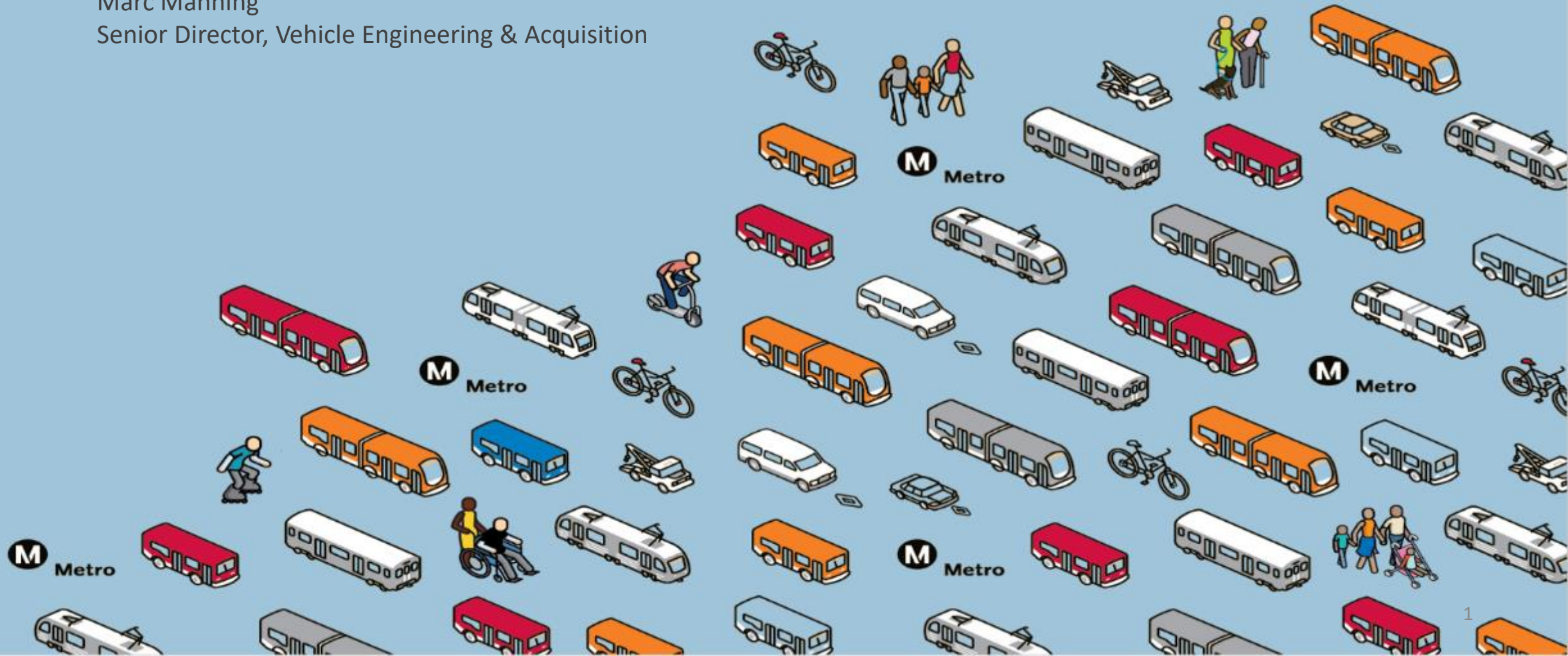
L.A. Metro's Battery Electric Bus Overview

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Battery Electric Buses: Meeting the Infrastructure Challenge

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System Overview

- Bus Service
 - Service Area of 1,433 sq. miles
 - 170 Bus Routes
 - Ridership of ~285 Million in 2017
 - Metro has 14 Divisions with 2367 buses
 - 388 60 ft Buses
 - 1979 Non-Articulated Buses
 - 637 45 ft Buses
 - 1292 40 ft Buses
 - 50 32 ft Buses.
 - 3 Divisions are contracted (176 buses)
 - 3 Sub-fleets
 - Red Buses are Rapid
 - Poppy Buses are Local
 - Silver Buses are Express
- (Silver and Orange Line BRTs)



Rapid Bus



Local Bus



Express Bus



System Vehicle Block Information

Vehicle Block Range (miles)	# of Blocks	Cumulative %	Battery Capacity (kW-hr)	2017 Battery Cost Per Bus	2030 Battery Cost Per Bus
0 - 25	166	5%	103	\$ 21,515	\$ 7,206
25 - 50	754	30%	206	\$ 43,029	\$ 14,412
50 - 75	543	47%	309	\$ 64,544	\$ 21,618
75 - 100	309	57%	412	\$ 86,059	\$ 28,824
100 - 125	342	69%	515	\$107,574	\$ 36,029
125 - 150	367	80%	618	\$129,088	\$ 43,235
150 - 175	260	89%	721	\$150,603	\$ 50,441
175 - 200	161	94%	824	\$172,118	\$ 57,647
200 - 225	105	97%	926	\$193,632	\$ 64,853
225 - 250	53	99%	1029	\$215,147	\$ 72,059
250 - 275	18	100%	1132	\$236,662	\$ 79,265
275 - 300	2	100%	1235	\$258,176	\$ 86,471
300 - 325	4	100%	1338	\$279,691	\$ 93,676
325 - 350	1	100%	1441	\$301,206	\$100,882

- Estimated Battery Capacity based on 3.5 kW-hr/mile
 - Highest average energy consumption experienced by LA Metro
 - Assumes All Bus Lengths with same energy consumption.
- 85% of battery capacity is usable.
- This doesn't account for end of life.
- Doesn't consider GVWR impact of Battery Capacity.
- Battery cost per bus based on Bloomberg New Energy Finance (2018). *Electric Buses in Cities*.
 - 2017: \$209/kW-hr
 - 2030: \$70/kW-hr



Metro



Battery Electric Bus Vehicle Block Information

Vehicle Block Range (miles)	Silver Line		Orange Line		Other	
	# of Blocks	Cumulative %	# of Blocks	Cumulative %	# of Blocks	Cumulative %
0 - 25	0	0.00%	0	0.00%	166	5.62%
25 - 50	0	0.00%	7	12.50%	747	30.90%
50 - 75	19	25.68%	17	42.86%	507	48.05%
75 - 100	13	43.24%	0	42.86%	296	58.07%
100 - 125	16	64.86%	5	51.79%	321	68.93%
125 - 150	5	71.62%	3	57.14%	359	81.08%
150 - 175	5	78.38%	4	64.29%	251	89.58%
175 - 200	4	83.78%	5	73.21%	152	94.72%
200 - 225	0	83.78%	2	76.79%	103	98.21%
225 - 250	2	86.49%	10	94.64%	41	99.59%
250 - 275	6	94.59%	3	100.00%	9	99.90%
275 - 300	1	95.95%	0	100.00%	1	99.93%
300 - 325	2	98.65%	0	100.00%	2	100.00%
325 - 350	1	100.00%	0	100.00%	0	100.00%

- Electrifying 2 Bus Rapid Transit (BRT) Lines – Orange & Silver Lines
 - En-Route Charging achieves Vehicle Blocks not allowed with existing technology
 - Reduces Capital Cost required for High Voltage Batteries



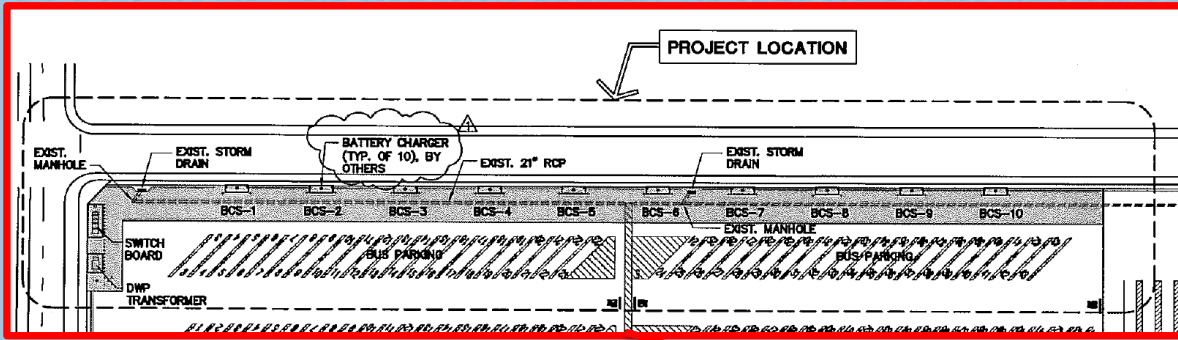
Orange Line – Route Overview



OEM	Length	Base Order (Option)	Battery Capacity (kW-hr)	Charging Strategy	
				Depot	En-Route
New Flyer	60'	40 (65)	250	J1772 CCS1 (150 kW)	SAE 3105-1 (450 kW)
BYD	60'	5	610	BYD AC (200 kW)	



Orange Line - Division 8 Depot Charging

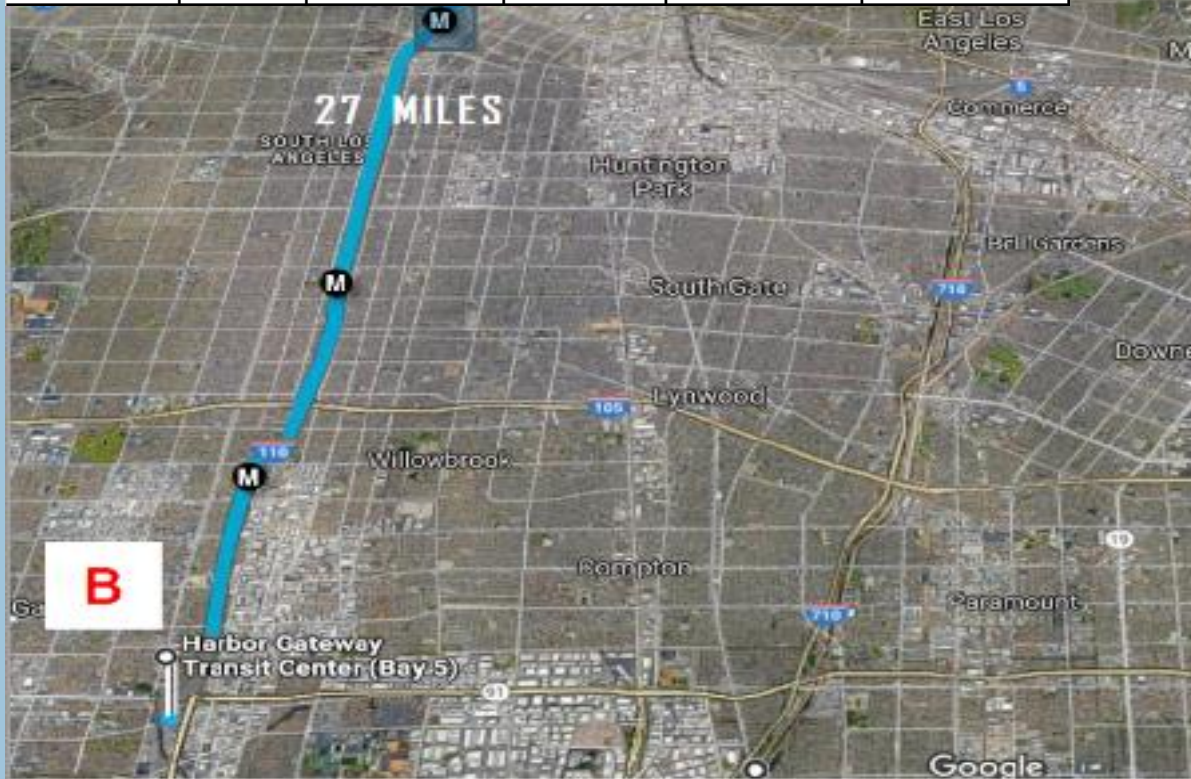


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Silver Line – Route Overview

OEM	Length	Base Order (Option)	Battery Capacity (kW-hr)	Charging Strategy	
				Depot	En-Route
BYD	40'	60 (40)	348	BYD AC (80 kW)	SAE 3105-1 (300 kW)



Silver Line – Division 9 Depot Charging



Zero Emission Bus Master Plan

- Utilize Consultant Services to develop strategies to meet goal of 100% ZE Bus operations by 2030. The Scope of Services includes:
 - Industry Outreach
 - Inventory of Metro's Operations
 - Assessment of Best Industry Practices
 - Evaluation of Compliance with Existing Standards and Codes
 - Support Negotiations of Rate Structures with Utilities
 - Analysis/System Modeling and Phase Options
 - Submittal of Master Plan
 - Develop Action Ready RFP's



Thank you

