Zero Emission Transit Buses

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Background

- California Air Resources Board has proposed a “Zero Emission Bus” (ZEB) rule
  - Applicable to all California Transit Agencies
  - All buses must be “zero emission” by 2040
  - Only electric & fuel cell buses qualify as ZEB
- Local Transit Agencies
  - Successfully transitioned to CNG buses
  - Larger transit agencies support near-zero engine technology combined with RNG
  - Continuing to assess ZEBs

Battery Electric Buses

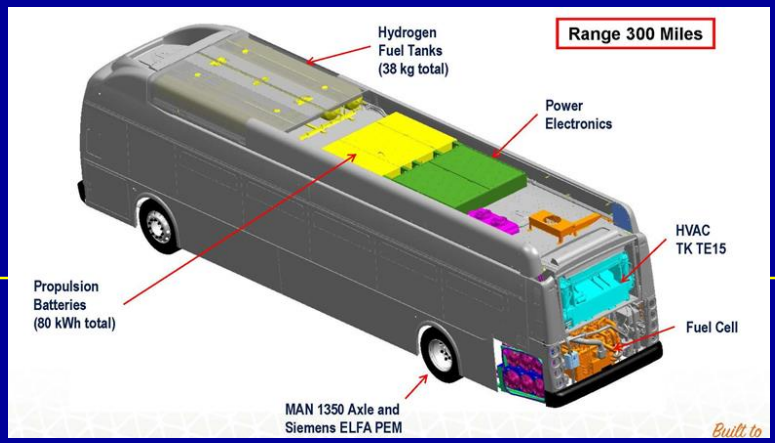
- Proterra
  - 53-131 kWh battery – Lithium Titanate
  - 10 minute recharge
  - Recently developed longer range bus
    - 129-321 kWh battery - 1 hour charge time
    - Up to 180 miles
- BYD
  - 324 kWh battery – LiFePO4 - 4 hour recharge
  - 150+ miles

Battery Electric Buses
Cont'd.

- New Flyer
  - 100–300 kWh Lithium Ion – Fast Charging
  - Up to 140 Mile
- Complete Coach Works
  - 242 kWh Lithium Ion - 4-5 hours recharge
  - Up to 115 miles
- Alexander Double Decker
  - 84 passenger – similar to articulated buses
  - BYD propulsion system

Fuel Cell Buses

- New Flyer
  - Ballard HD85 Module
  - 80 kWh battery pack Li-FePo4
  - 4 hydrogen tanks – 350 Bar/38 kg
  - Siemens ELFA Drive System
  - 300 Mile Range/6 min fill time
- El Dorado National
  - Ballard/BAE
  - 11 KWh battery pack – Li Ion
  - 8 hydrogen tanks – 350 Bar/50 kg
  - 300 Mile Range/6 min fill time



Analysis done by Ramboll/Environ for LACMTA – CARB currently evaluating

Cost Effectiveness 2015 – 2055 ($/ton)

		LNOx + RNG	ELECTRIC BUS		FUEL CELL BUS	
			Depot Charge	Depot & In-route	SMR	ELECTR
Compared to Baseline	Cost Increase (NPV $ million)	$161.3	$2,154.9	$1,224.5	$1,420.7	$1,992.4
	GHG Reduction (million tons)	11.4	8.3	8.4	3.3	6.7
	In-basin NO_x Reduction (tons x 000)	2.7	2.9	2.9	0.1	2.5
Cost Effectiveness ($/ton) [1]	GHG	$14	$259	$146	$432	$296
	IB NO_x	$59,000	$755,000	$427,000	$20 mill	$795,000

[1] Assumes that 100% of cost increase attributed to each pollutant

MJB & A

Summary

- In the short-term, continue to support larger scale deployment of near-zero emission engines with renewable fuels
- Continue to support development, demonstration and deployment of zero emission buses
- Continue to evaluate and support infrastructure (electric and hydrogen) for medium- and heavy-duty uses