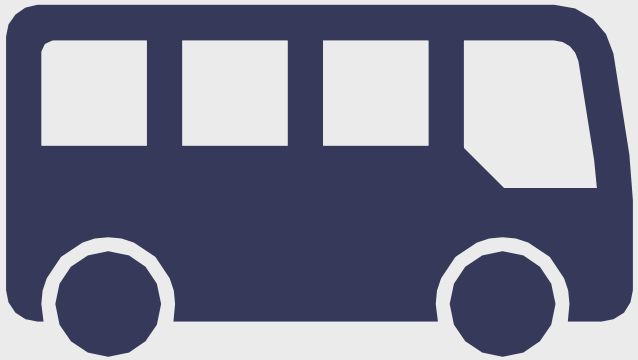
Los Angeles County Metropolitan Transportation Authority

Zero Emission Bus Options

Presentation for the Los Angeles County Integrated Waste Management Task Force

Kawsar Vazifdar - August 20, 2020



The Study

- Completed in 2016
- This analysis estimates exhaust emissions, capital costs, and operating costs for the LACMTA bus fleet over a 40-year period (2015 –2055) under five different future bus technology/fuel purchase scenarios.
- The LACMTA bus fleet:
  - Consist of 2,194 urban transit buses
  - Operates on compressed natural gas (CNG)
  - 7% of the fleet is replaced each year with new buses

Future Bus Technology/Fuel Scenarios:

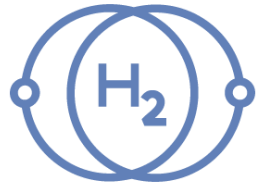
BASELINE

RENEWABLE NATURAL GAS

RENEWABLE NATURAL GAS + LOW NOx

ELECTRIC BUSES

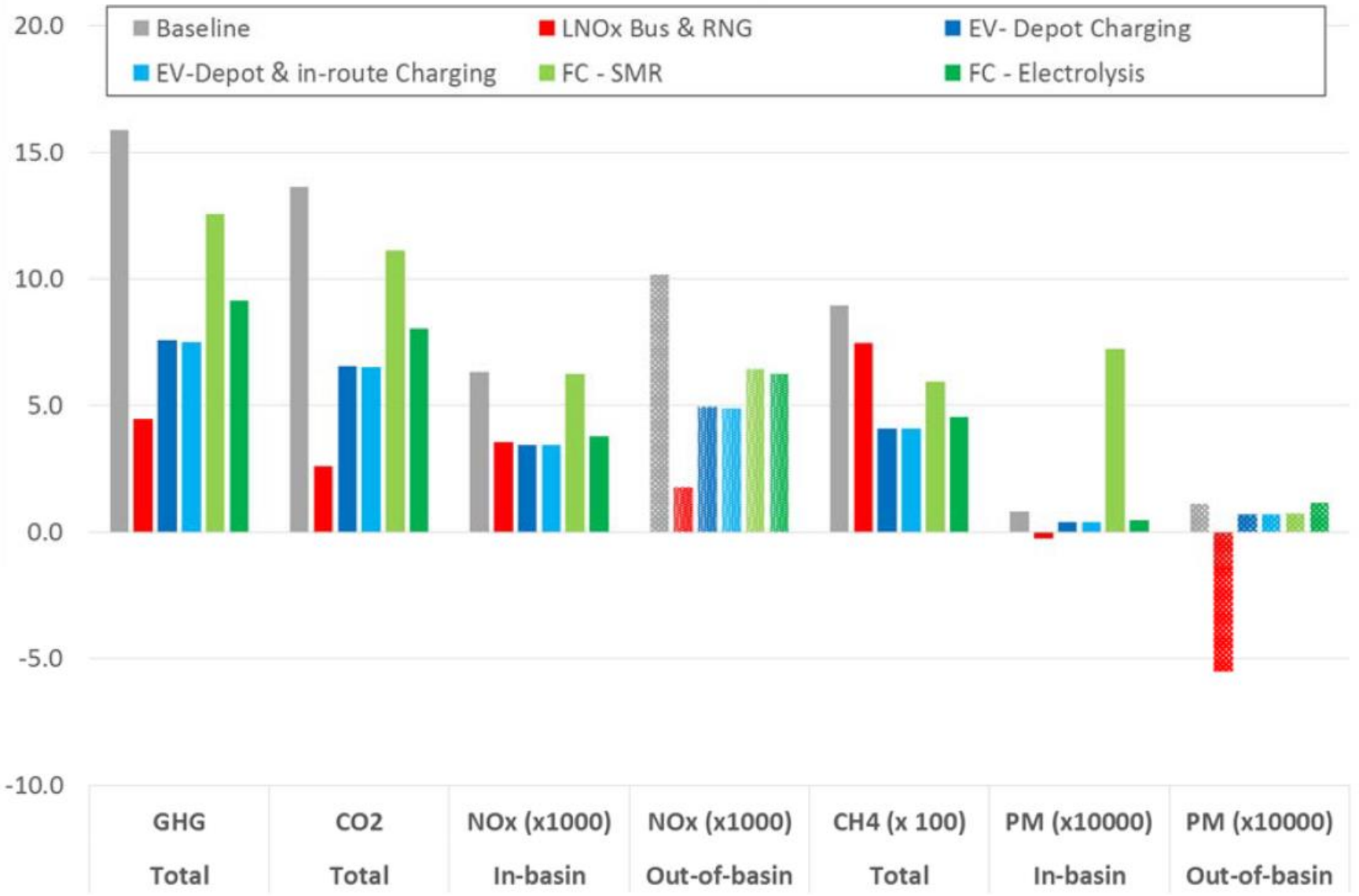
FUEL CELL BUSES



Reduction in Pollutants (2015-2055)

Scenario		Nitrogen Oxides (NOx)		Particulate Matter (PM)		Greenhouse Gases (GHG)	Methane (CH_4)	Carbon Dioxide (CO_2)
		In LA Basin	Outside LA Basin	In LA Basin	Outside LA Basin			
Baseline (tons)		6,296	10,157	81.1	110.4	15,877,260	89,590	13,637,506
Renewable Natural Gas		-1%	82%	128%	600%	70%	2%	81%
Renewable Natural Gas with Low NOx		43%	82%	131%	601%	72%	17%	81%
Electric		46%	52%	51%	38%	53%	54%	52%
Fuel Cell	SMR	1%	37%	-792%	34%	21%	34%	19%
	Elec.	40%	39%	39%	-6%	42%	49%	41%

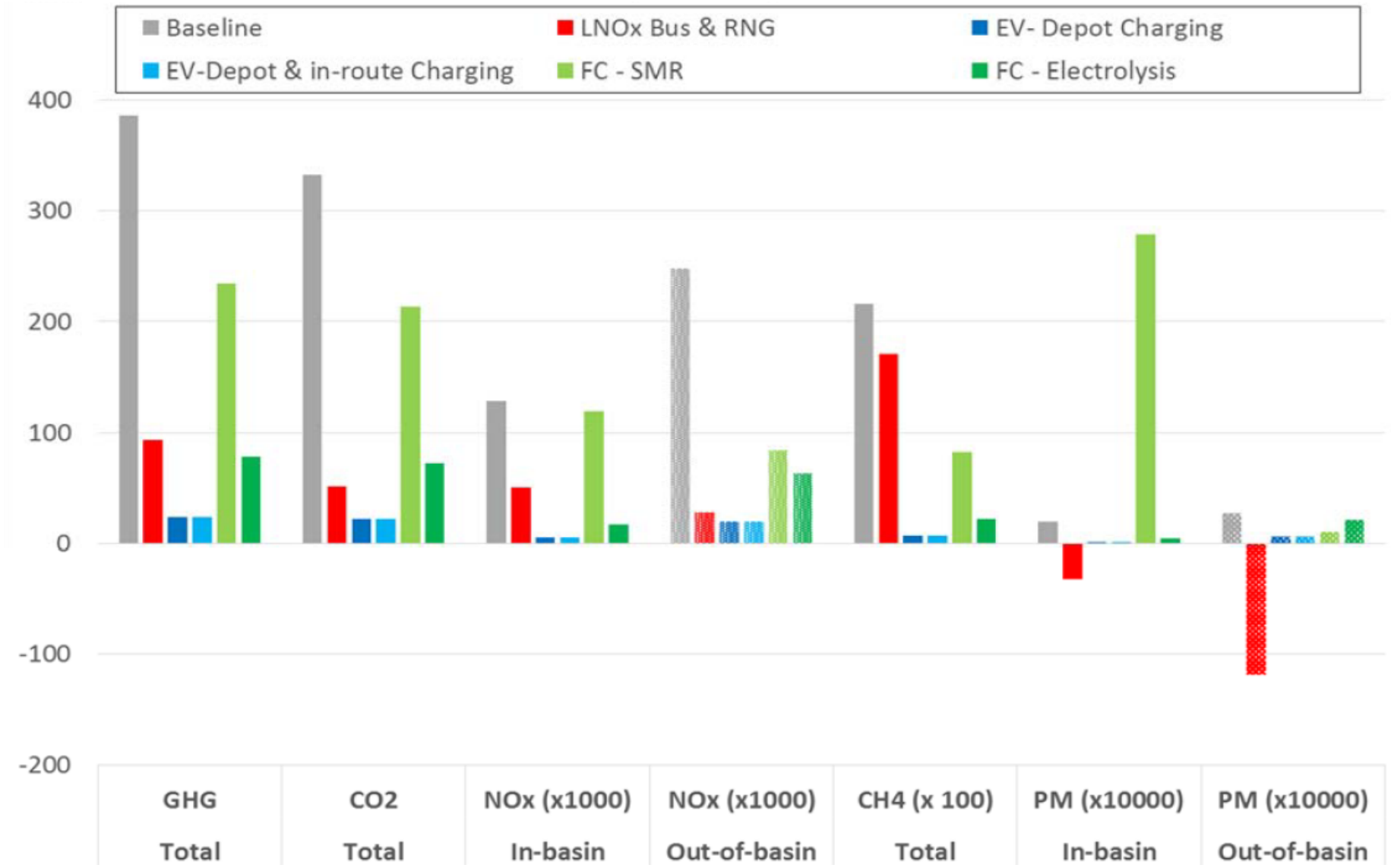
Total Fleet Emissions 2015-2055 (million tons)



Reduction in Pollutants (2055)

Scenario		Nitrogen Oxides (NOx)		Particulate Matter (PM)		Greenhouse Gases (GHG)	Methane (CH_4)	Carbon Dioxide (CO_2)
		In LA Basin	Outside LA Basin	In LA Basin	Outside LA Basin			
Baseline (tons)		129	248	2	3	386,554	2,157	332,622
Renewable Natural Gas		-6%	89%	261%	540%	73%	3%	85%
Renewable Natural Gas with Low NOx		61%	89%	266%	542%	76%	21%	85%
Electric		96%	92%	93%	77%	94%	97%	93%
Fuel Cell	SMR	7%	66%	-1,337%	61%	39%	62%	36%
	Elec.	87%	74%	78%	23%	80%	90%	78%

Annual Fleet Emissions in 2055 (tons)



Cost Increase

Scenario		Capital Cost	Operating Cost	Net Increase in Costs ($ million)	Cost Effectiveness of Emission Reductions	
					$/ton GHG	$/ton NOx
Baseline (tons)		$2,463	$13,814	NA	NA	NA
Renewable Natural Gas		0%	0%	$0	NA	NA
Renewable Natural Gas with Low NOx		6%	0.2%	$173	$15	$63,500
Electric	Depot Only	40%	-2%	$768	$94	$271,000
	Depot & In-Route	34%	-3%	$376	$46	$133,000
Fuel Cell	SMR	61%	-0.8%	$1,380	$420	$20,250,000
	Elec.	61%	1%	$1,680	$250	$671,000

Summary

- From 2015-2055, the use of RNG and transition to LNOx buses will be more effective at reducing in-basin and out-of-basin PM, total CO2, total GHGs, and total NOx from the LACMTA fleet. It will be slightly less effective at reducing in-basin NOx.

- After 2055, electric buses are projected to have the lowest annual GHG emissions compared to RNG plus LNOx buses.

- The use of RNG and transition to LNOx buses will be the most cost effective compared to other fuel purchase options.

Recent Developments

- **2017:** Metro endorsed a plan to transition to a 100% zero emission bus fleet by 2030, replacing about 200 buses per year.
- **2018:** Metro extended its one-year contract to purchase RNG from Clean Energy for an additional four years. Metro is upgrading current CNG buses to "Near-Zero" Low NOx engines at mid-life.
- **2019:** Metro tested the first zero emission electric bus with a goal to electrify the Metro G Line by December 2020.
- **2020:** CARB passed the Advanced Clean Truck Regulation (ACT) that mandates a large-scale transition of medium-and heavy-duty vehicles to zero-emission.
- **2021:** Metro plans convert the J Line to zero emission buses.

Questions?