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California Energy Commission

2019 IEPR Preliminary Medium- and Heavy-duty Vehicle Forecast

2019 IEPR Workshop on Transportation Energy Demand Forecast

Rosenfeld Hearing Room

July 22, 2019

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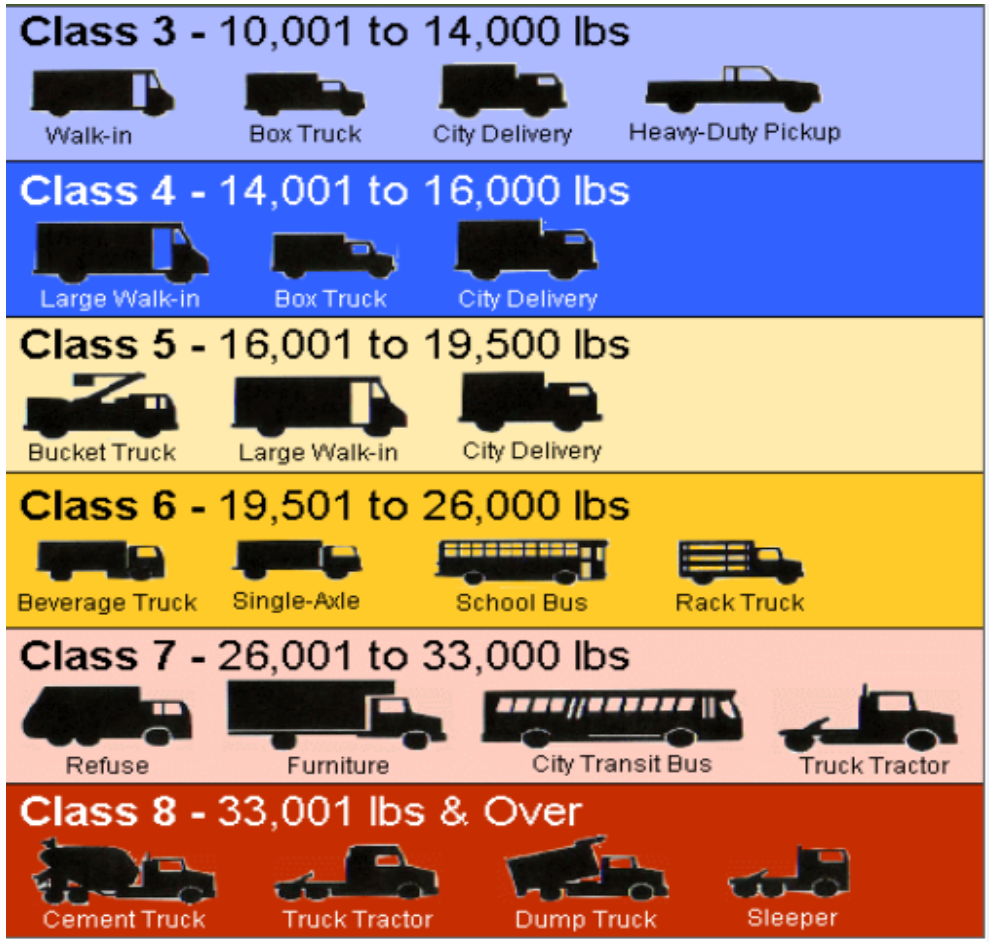
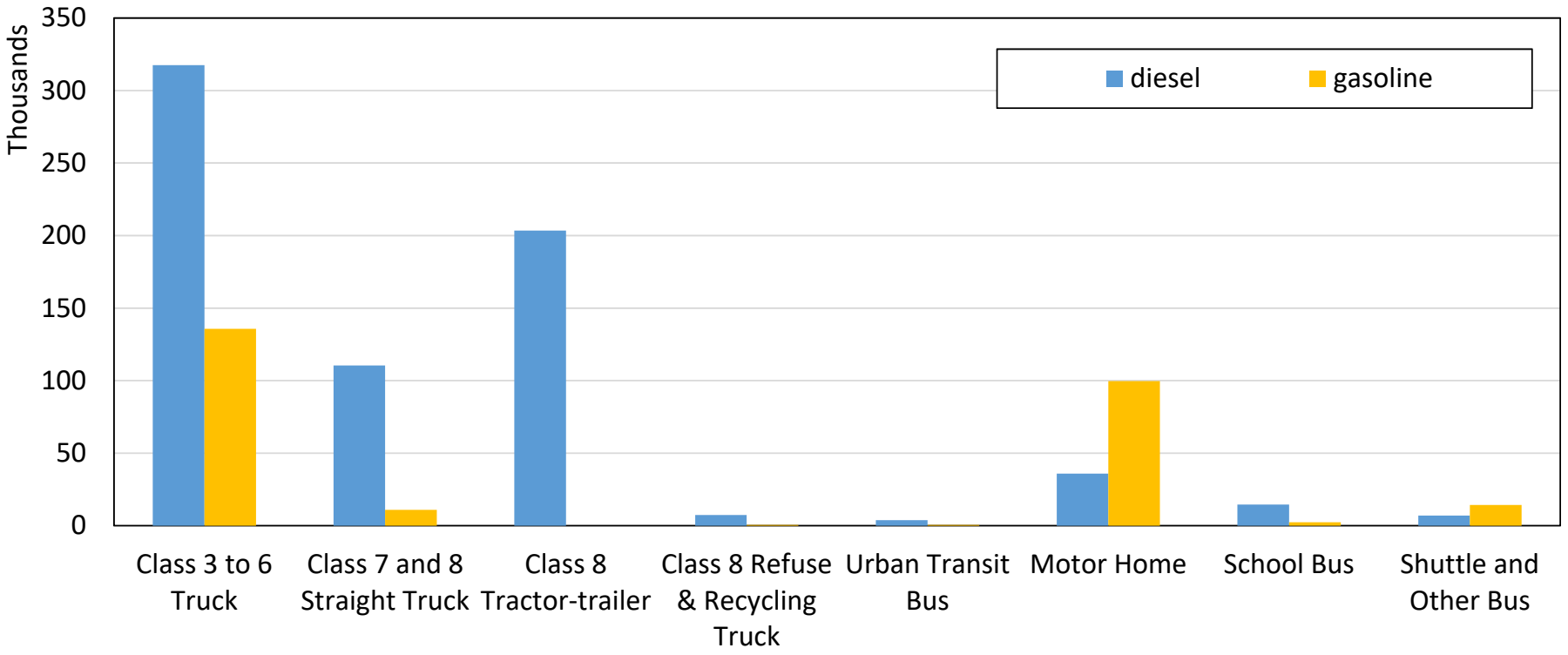
Topics in this presentation

- Description of new data sources and assumptions
- cale for electric freight trucks
- Overviews:
  - Fuel cost per mile,
  - Market share of incentivized trucks in key truck classes
  - Battery electric bus stock
  - Incentivized truck acquisitions and stock
- Plans for revised forecast

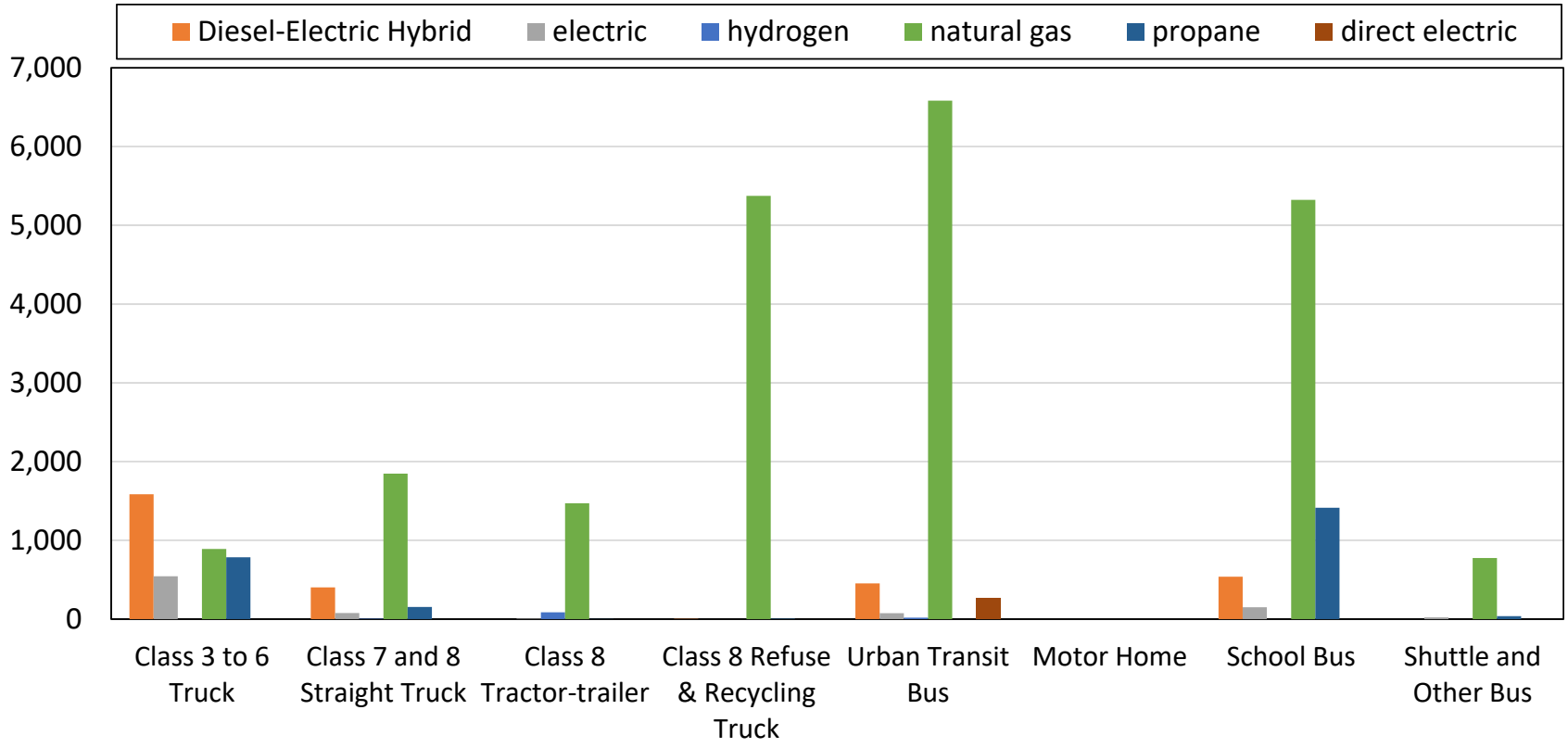
MD/HD Vehicle Classes



Base Year 2017 MD-HD Vehicle Stock
Diesel and Gasoline



Base Year 2017 MD-HD Vehicle Stock Alternative Fuels

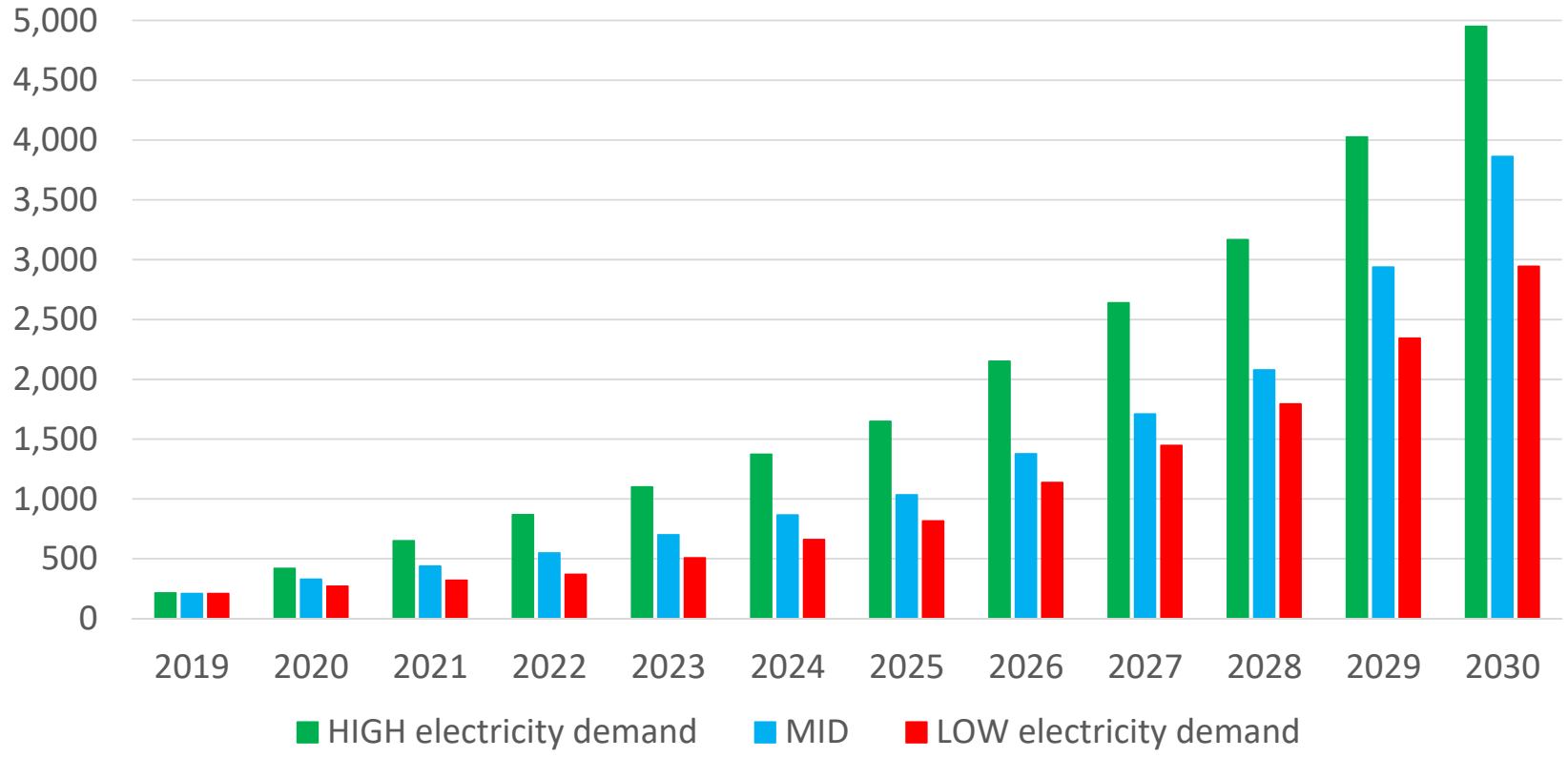


Innovative Clean Transit Regulations

- January 1, 2020: new conventional internal combustion engine bus or hybrid bus purchases must purchase buses with Low-NOx engines

- Large transit agencies must purchase a minimum number of zero-emission buses in each calendar year
  - 2023: 25 percent of the total number of new bus purchases
  - 2026: 50 percent of the total number of new bus purchases
  - 2029: 100 percent of the total number of new bus purchases

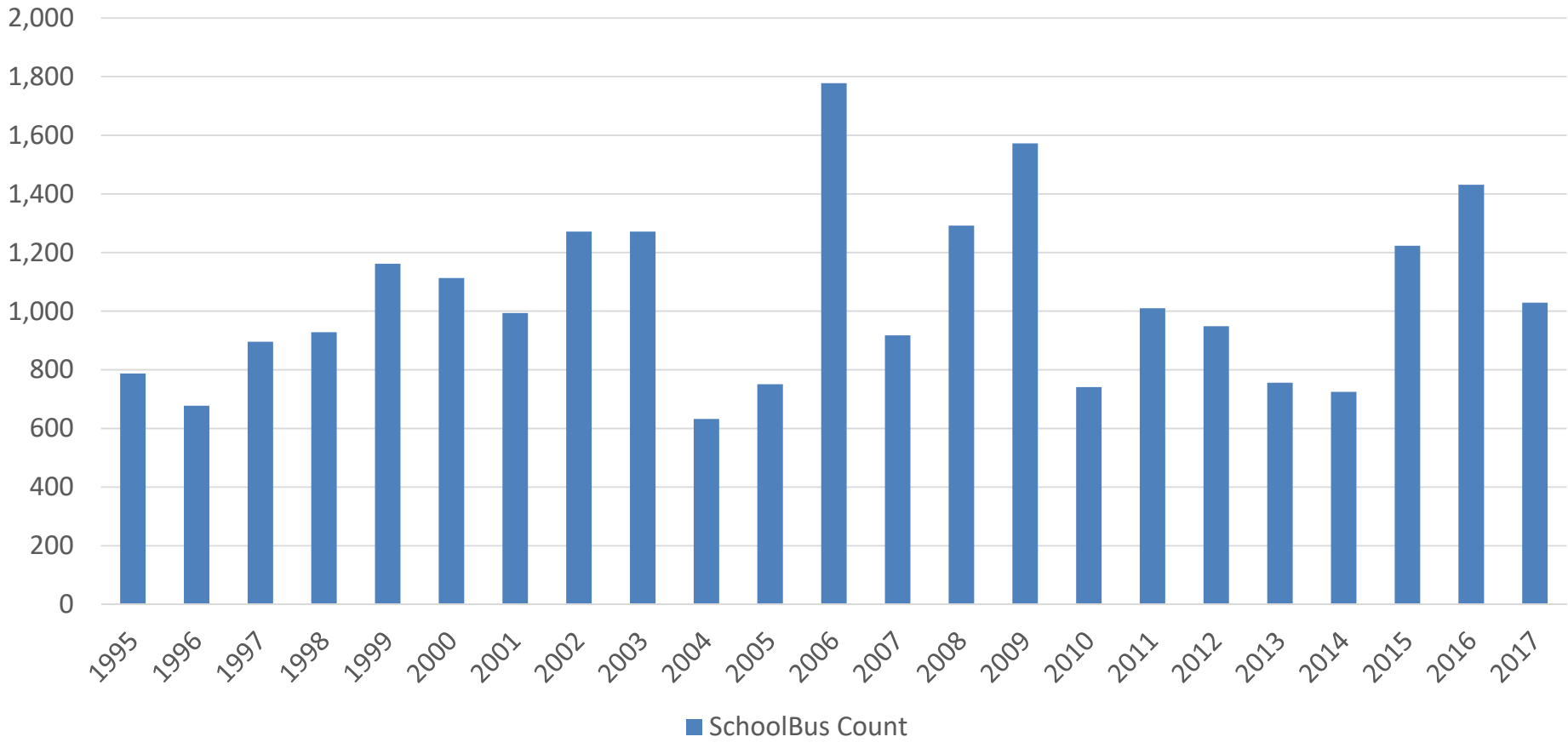
Battery Electric Urban Transit Bus Stock 2019-2030



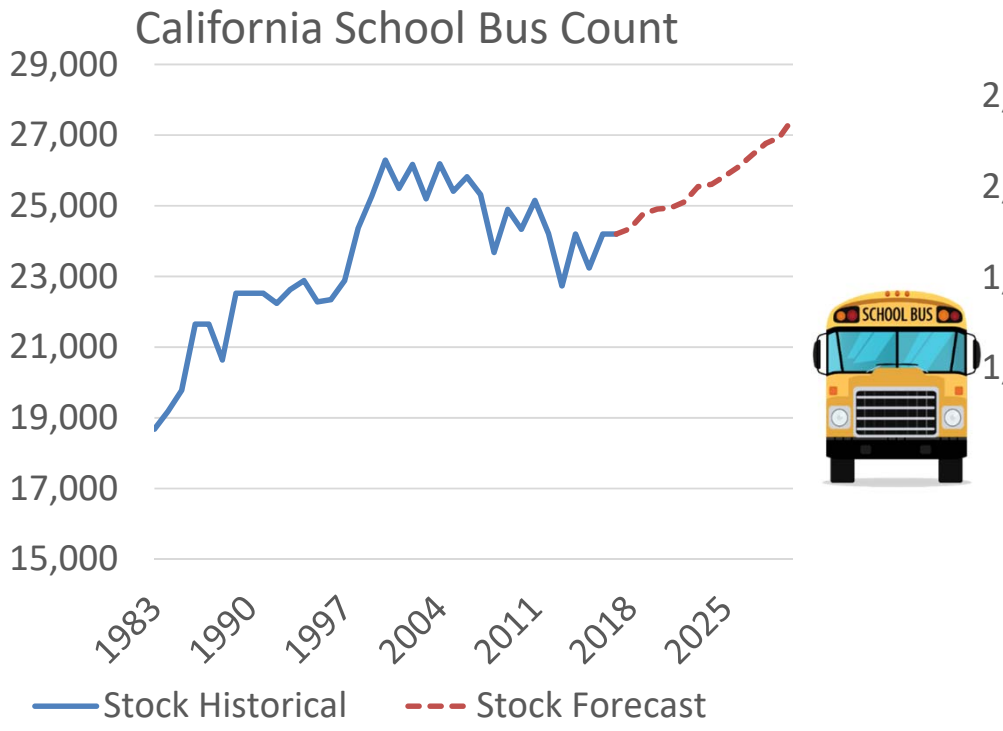
School Bus Funding Programs

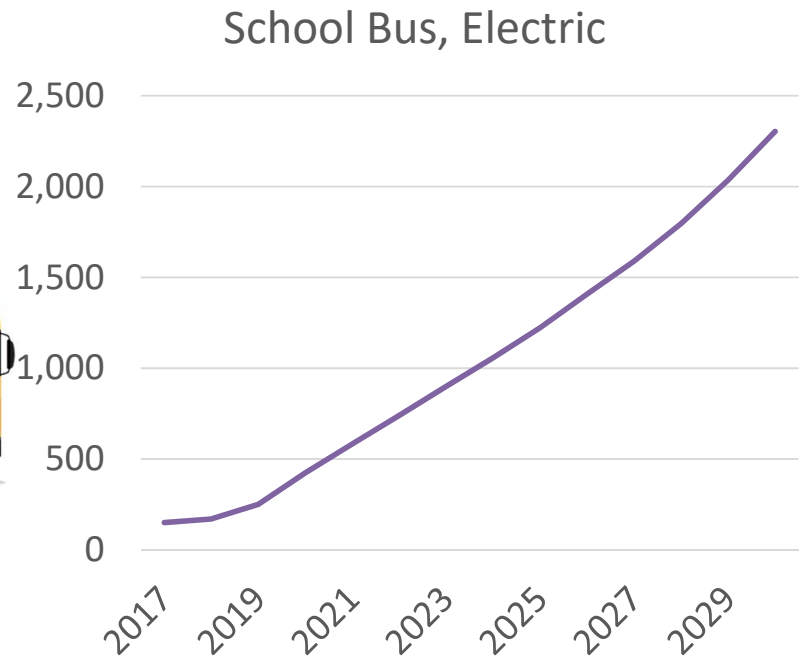
- School Bus Replacement (CEC)
- Electric School Bus Incentive Program (SJVAPCD)
- The Carl Moyer Program (Bay Area District)
- Lower-Emission School Bus Program (South Coast District)
- Rural School Bus Pilot Project (North Coast District)
- Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP-CARB)
- The Volkswagen Settlement/ Mitigation Funding
- Clean School Bus (US EPA)
  - DERA School Bus Rebate Program (US EPA)

2017 School Bus Population by Vintage



School Bus Electrification Forecast





Source: CHP historic, IEPR 2019 preliminary

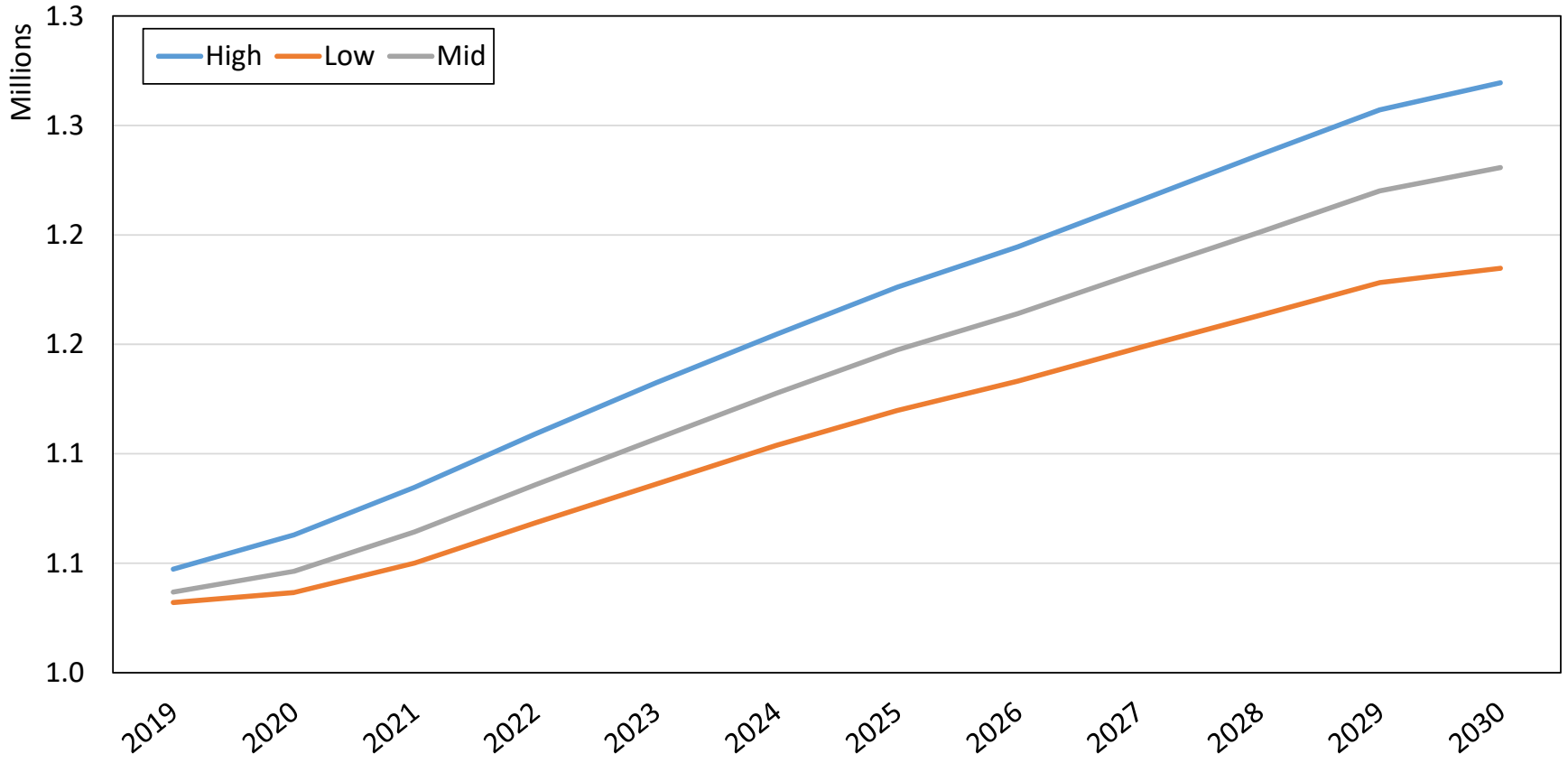
HVIP Incentive Truck Scenarios

- Air Resources Board Heavy Vehicle Incentive Program voucher amounts through 2018 inform truck choice for all classes
- High electricity demand case has full HVIP voucher amount through to 2030
- Mid case lowered to 90% of full voucher amount from 2023 to 2030
- Low electricity demand case has HVIP voucher curtailed to zero from 2023 on

Major Truck Data Changes

- Truck attributes prepared by HD Systems
- Freight Analysis Framework (FAF) v.4.4
  - Scenarios of goods movement prepared by IHS Global Insight for FHWA
  - Implicit modal share, split of freight movement by truck and rail
- California Vehicle Inventory and Use Survey data
  - Miles per truck by class and age, and whether using a home base
  - Percentage of trucks and truck miles in each of 42 group intervals of 5,000 annual miles, groups for zero to over 200,000 annual miles
- Newly revised truck price forecast and fuel economy trend from HD Systems
- Historic fuel economy from EMFAC2017

MD/HD Vehicle Stock Forecast
Trucks, Buses, Motorhomes



Two Battery Electric Vehicles, Different Weight

- Chevy Bolt curb weight is 3,563 pounds plus an average adult person's weight of 170 pounds
- Gross weight of the Xos ET-One is 80,000 pounds

Weight Ratio 21.4:1

A Xos ET-One fully loaded is 21.4 times the weight of the Bolt & driver.

Takeaway: A loaded truck needs over 20 times the battery an auto needs to cover the same range in the same drive cycle

Attributes Used in Truck Choice

INPUTS	Low	Mid	High
CARB Heavy Vehicle Incentive Program	constant % of incremental cost to 2022, zero thereafter	constant % of incremental cost to 2022, 90% thereafter	constant % of incremental cost to 2030

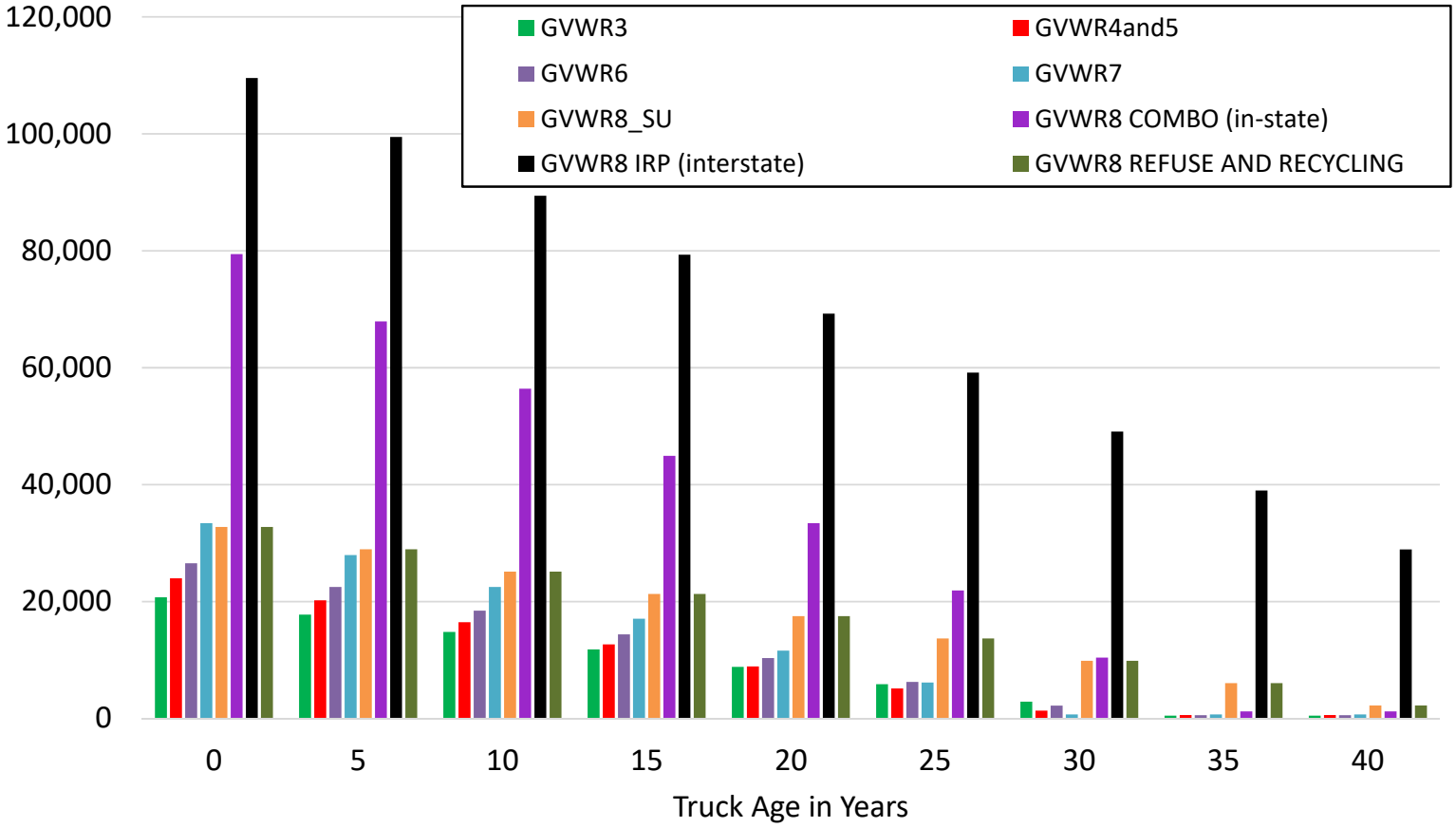
FUEL EFFICIENCY INCREASE FROM 2017 TO 2030 (DIESEL)	Low	Mid	High
GVWR3	23%	23.5%	23.5%
GVWR4and5	23%	28.2%	28.2%
GVWR6	25%	25.8%	25.8%
GVWR7	22.5%	22.90%	22.90%
GVWR8 Single unit (straight)	24.40%	24.90%	24.90%
GVWR8 In-state Tractor-trailer	26.7%	27.30%	27.30%
GVWR8 Interstate tractor-trailer	30.70%	31.40%	31.40%
GVWR8 Refuse / Recycling	9%	9.20%	9.20%

FORECAST (ZEV STOCK, 2030)	Low	Mid	High
GVWR3	166	3,159	7,107
GVWR4and5	842	704	8,021
GVWR6	269	3,830	5,173
GVWR8 In-state Tractor-trailer (battery)	5	2,105	4,901
GVWR8 In-state Tractor-trailer (catenary)	76	1,852	2,108

INCREMENTAL ZEV VEHICLE PRICE	2020	2025	2030
GVWR3	$40,235	$35,225	$30,710
GVWR4and5	$59,749	$52,461	$45,893
GVWR6	$88,751	$79,474	$71,115
GVWR8 In-state Tractor-trailer	$253,728	$233,838	$204,210

Annual Miles per Truck by Class and Age

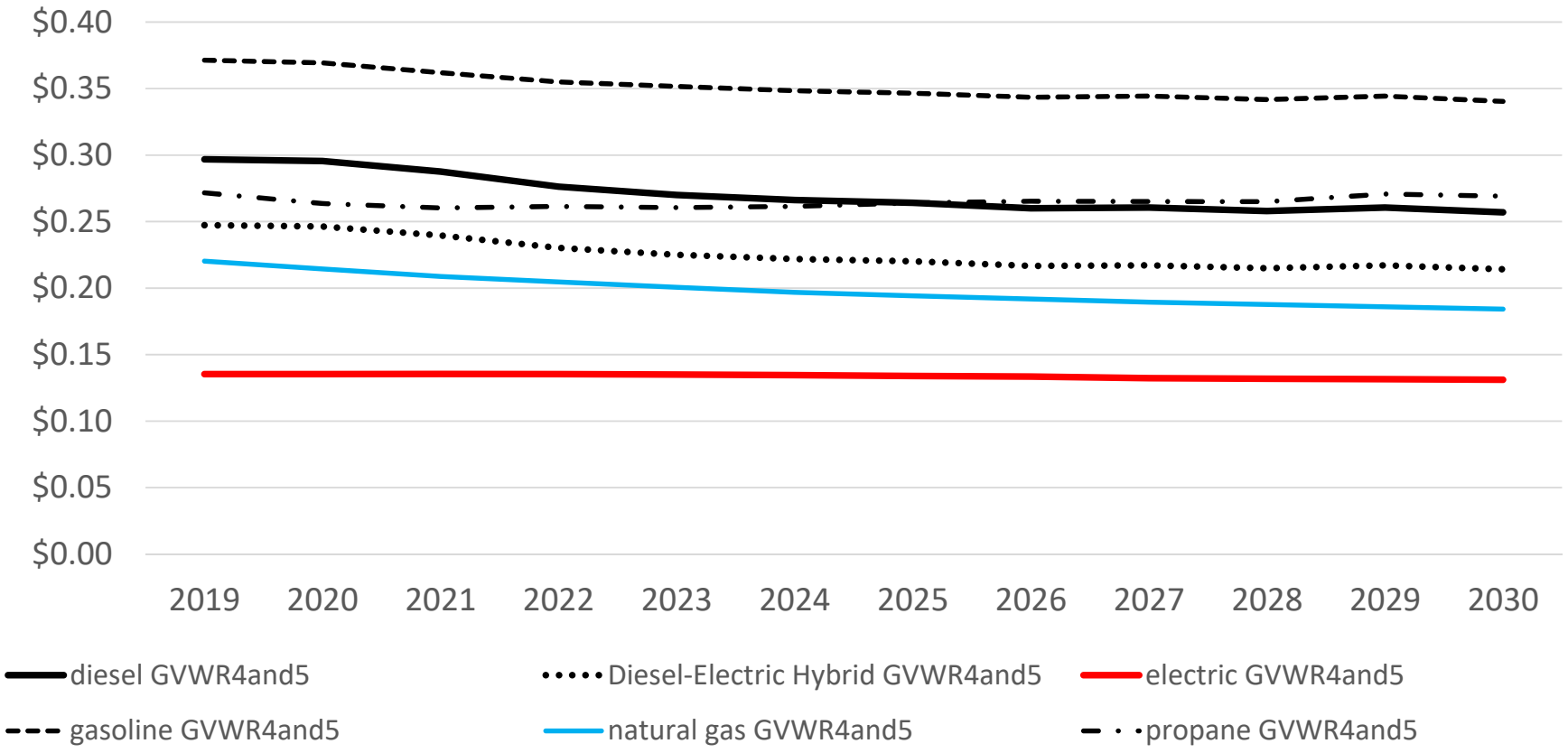
Estimated from 2017 California Vehicle Inventory and Use Survey



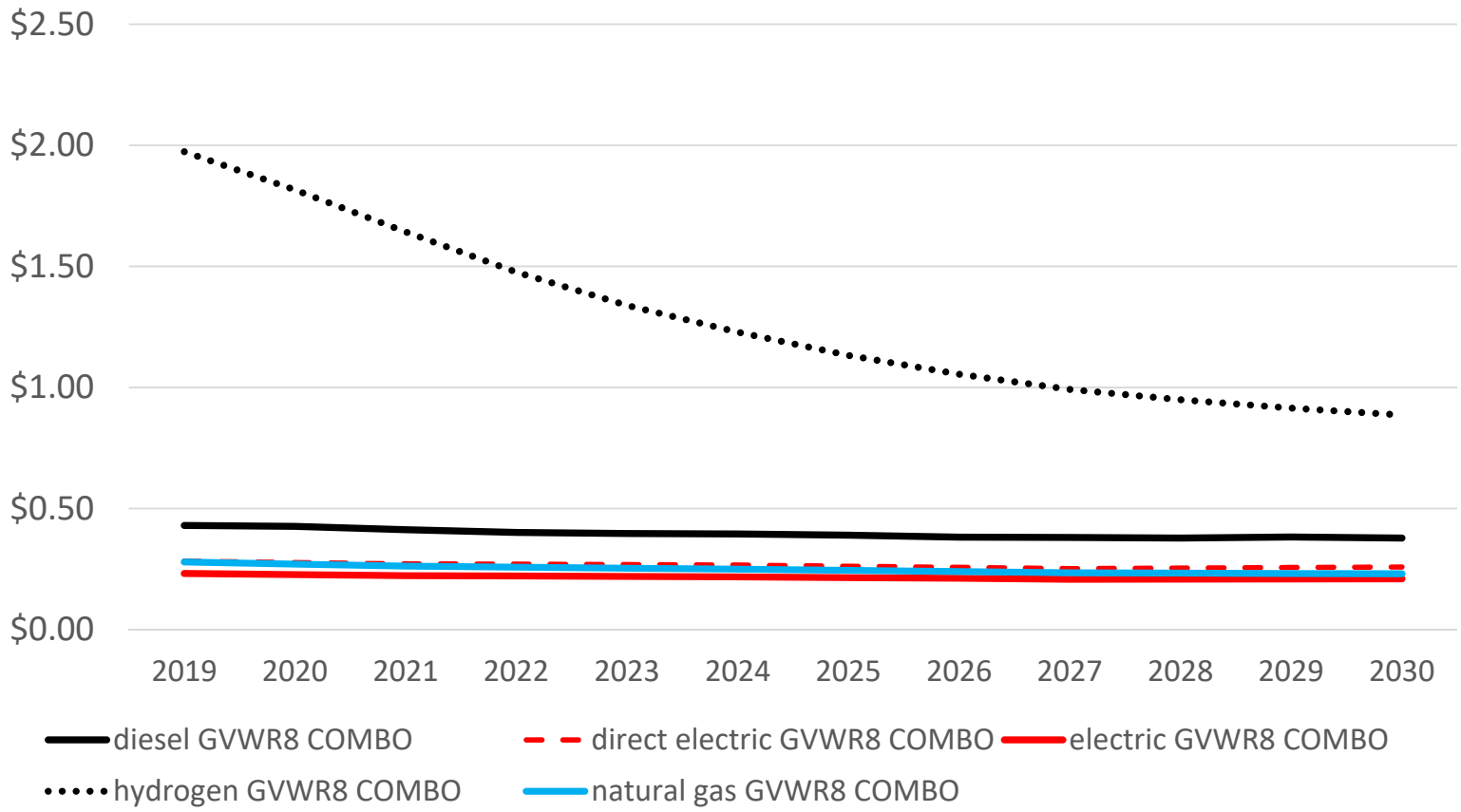
Fuel Types Applied to Truck Classes

O – OEM A – Aftermarket P – Pilot production	Truck Classes	Gasoline	Diesel	Diesel Electric Hybrid	Battery Electric Vehicles	FCV	E85	CNG	Liquefied Natural gas (LNG)	Propane
GVWR 3	GVWR 3	O	O	P	P		O	A		A
GVWR 4 to 6	GVWR 4	O	O	P	P		O	A		A
	GVWR 5	O	O		P		O	A		
	GVWR 6		O	P	P			A		
GVWR 7 & 8	GVWR 7		O	P				A		
	GVWR 8 Single Unit		O					A	A	
GVWR 8	Combination (California)		O		P	A		A	A	
GVWR 8	Garbage		O					A		
GVWR 8	IRP (combination)		O						A	
Motorhomes	GVWR 3	O	O							
	GVWR 4 to 6		O					A		
	GVWR 7 & 8		O					A		
Bus	Urban Transit		O	O	P	P		A		
	Motor Coach		O							
	School Bus	O	O		P			A		A

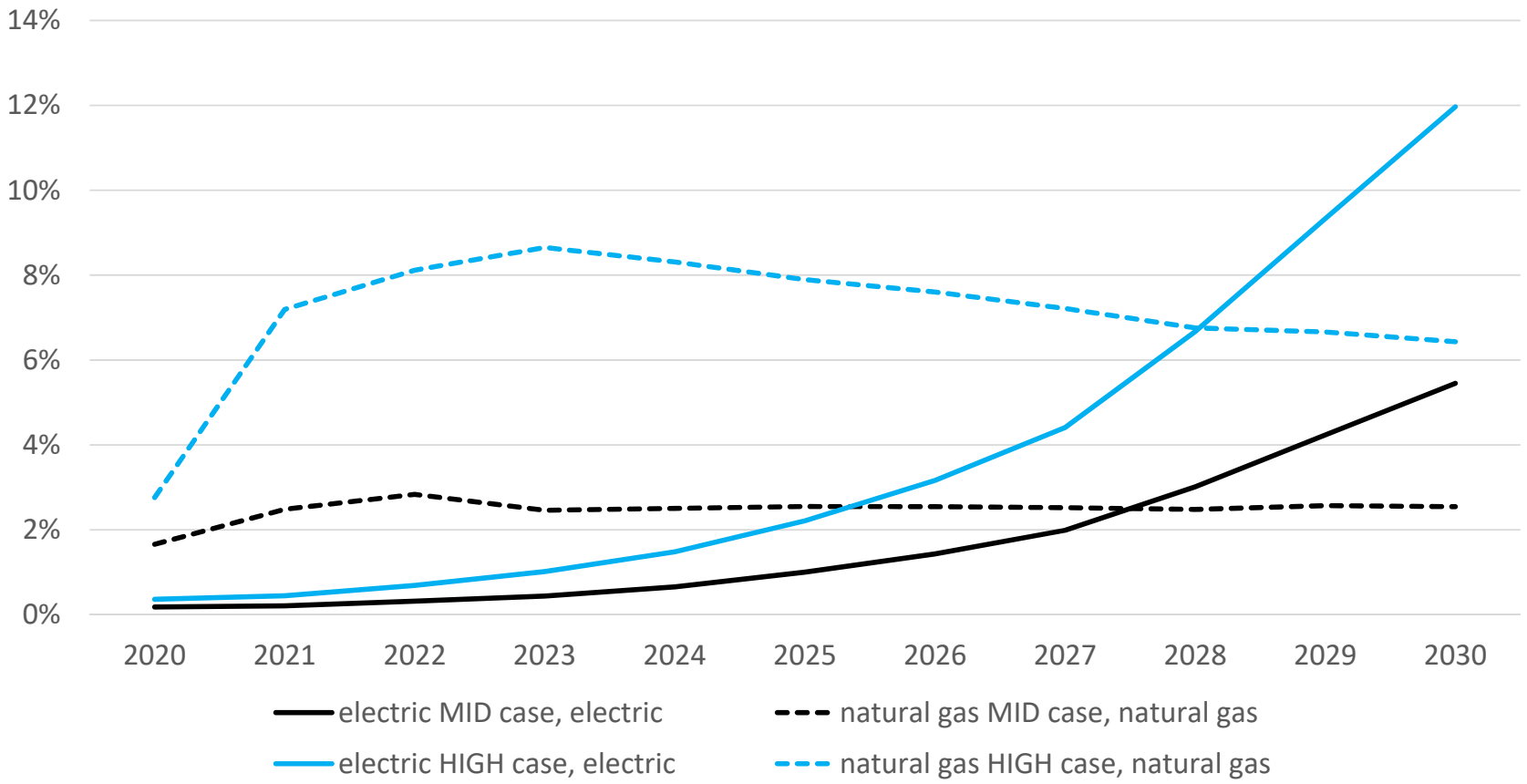
Fuel Cost per Mile, Mid case
Class 4 and 5 trucks and vans



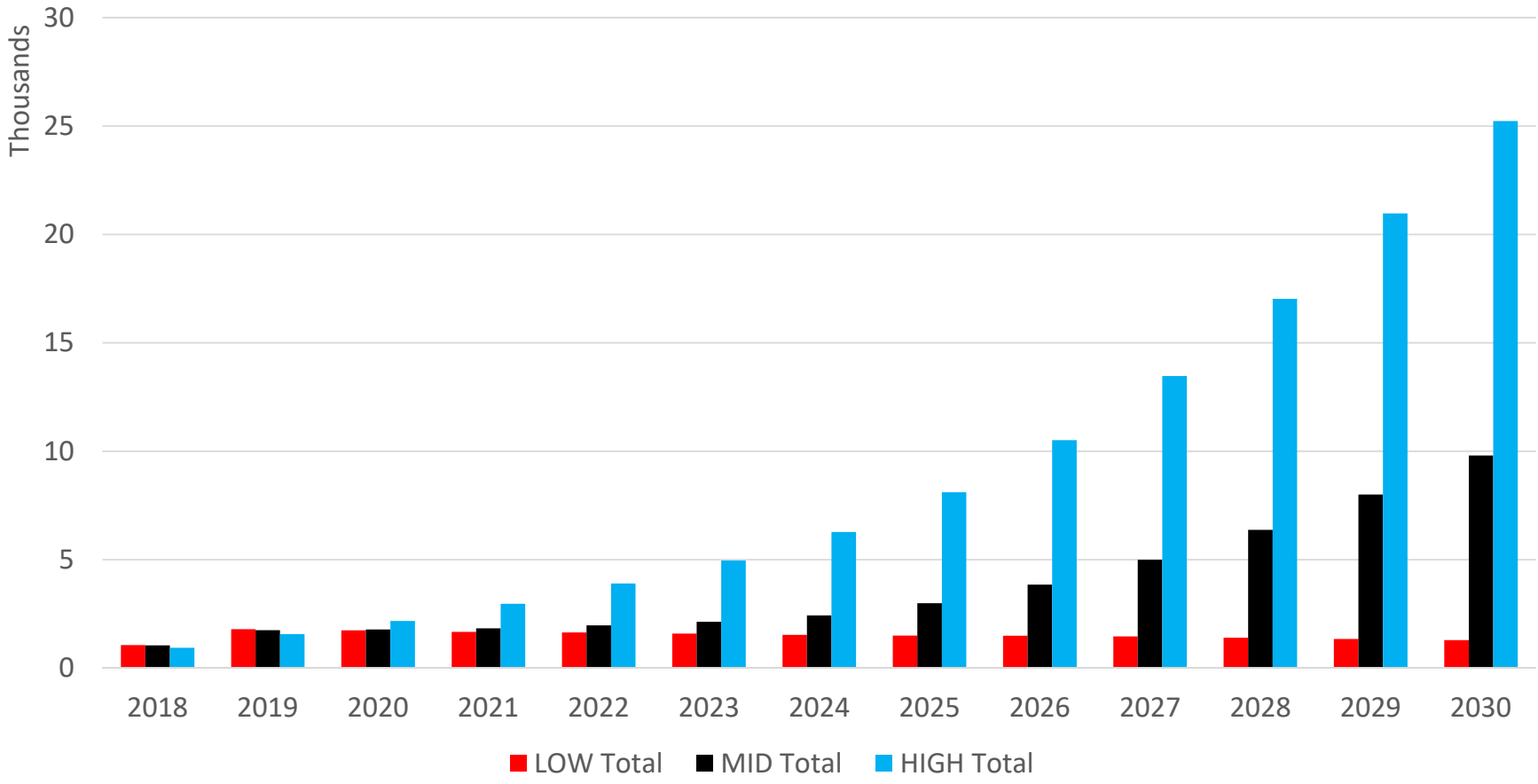
Fuel Cost per Mile, Mid Case
In-state Class 8 Tractor-trailer



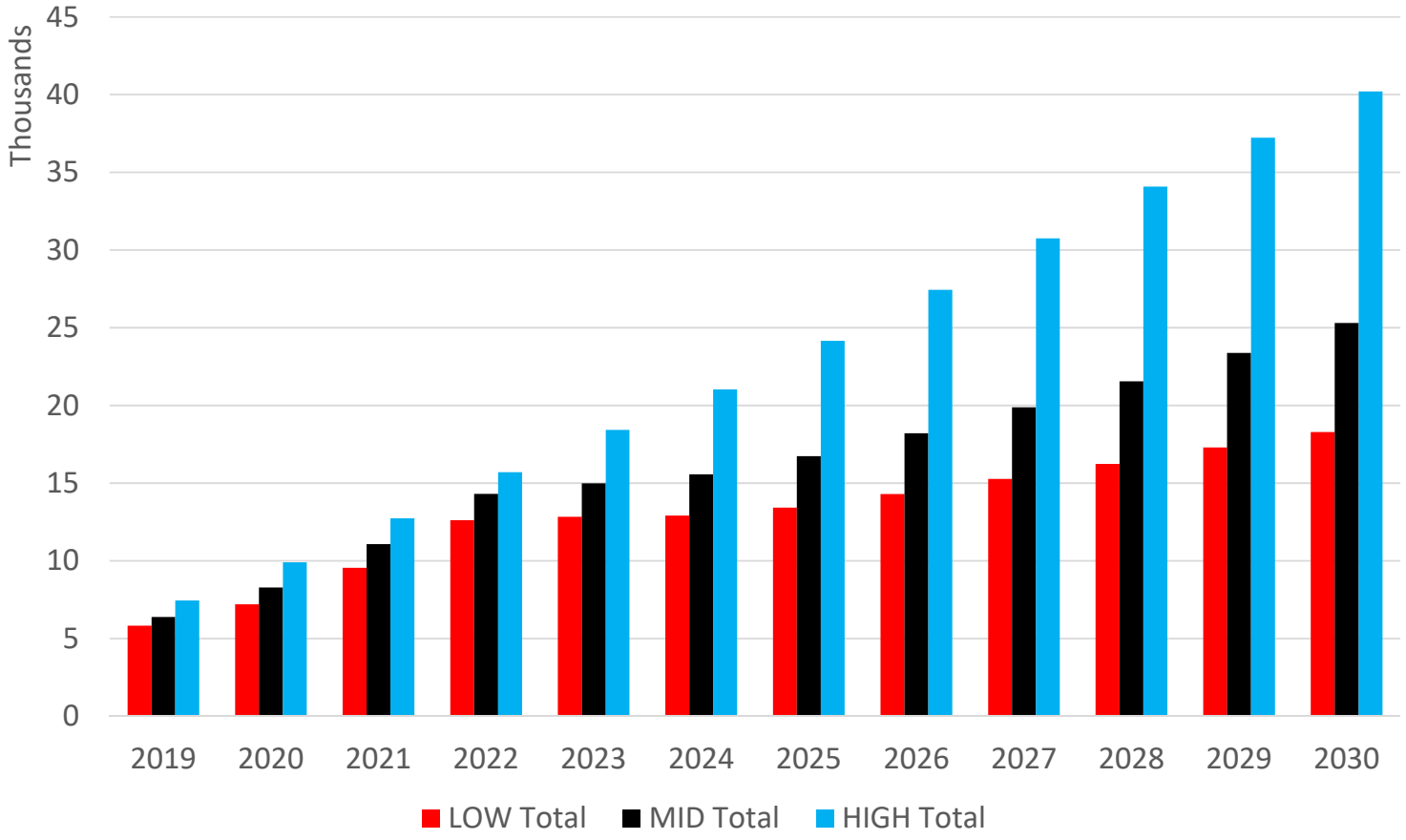
Incentivized Fuels, Market Share of New Truck Sales
In-state Class 8 Tractor-trailer



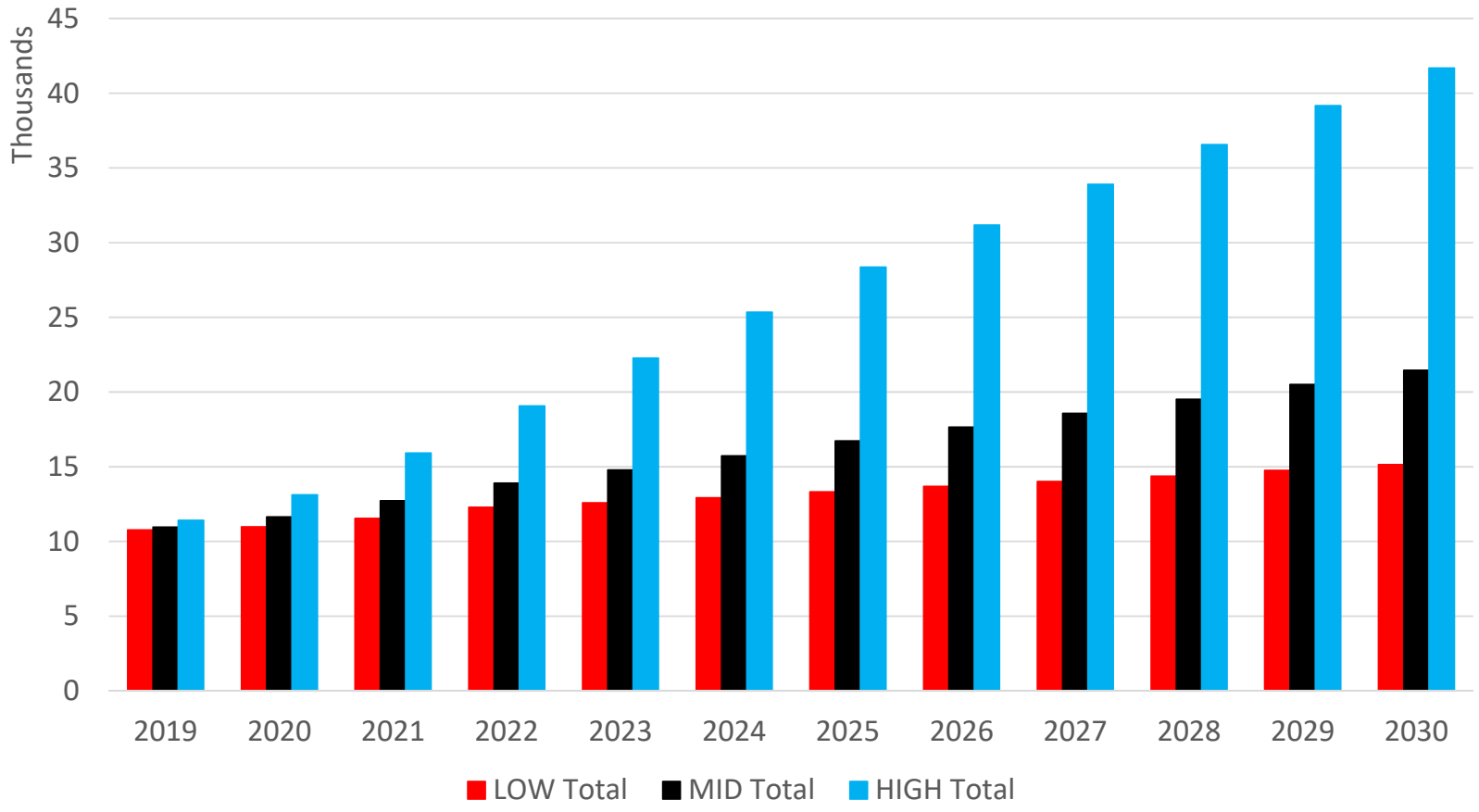
Incentivized Battery Electric Truck Stock



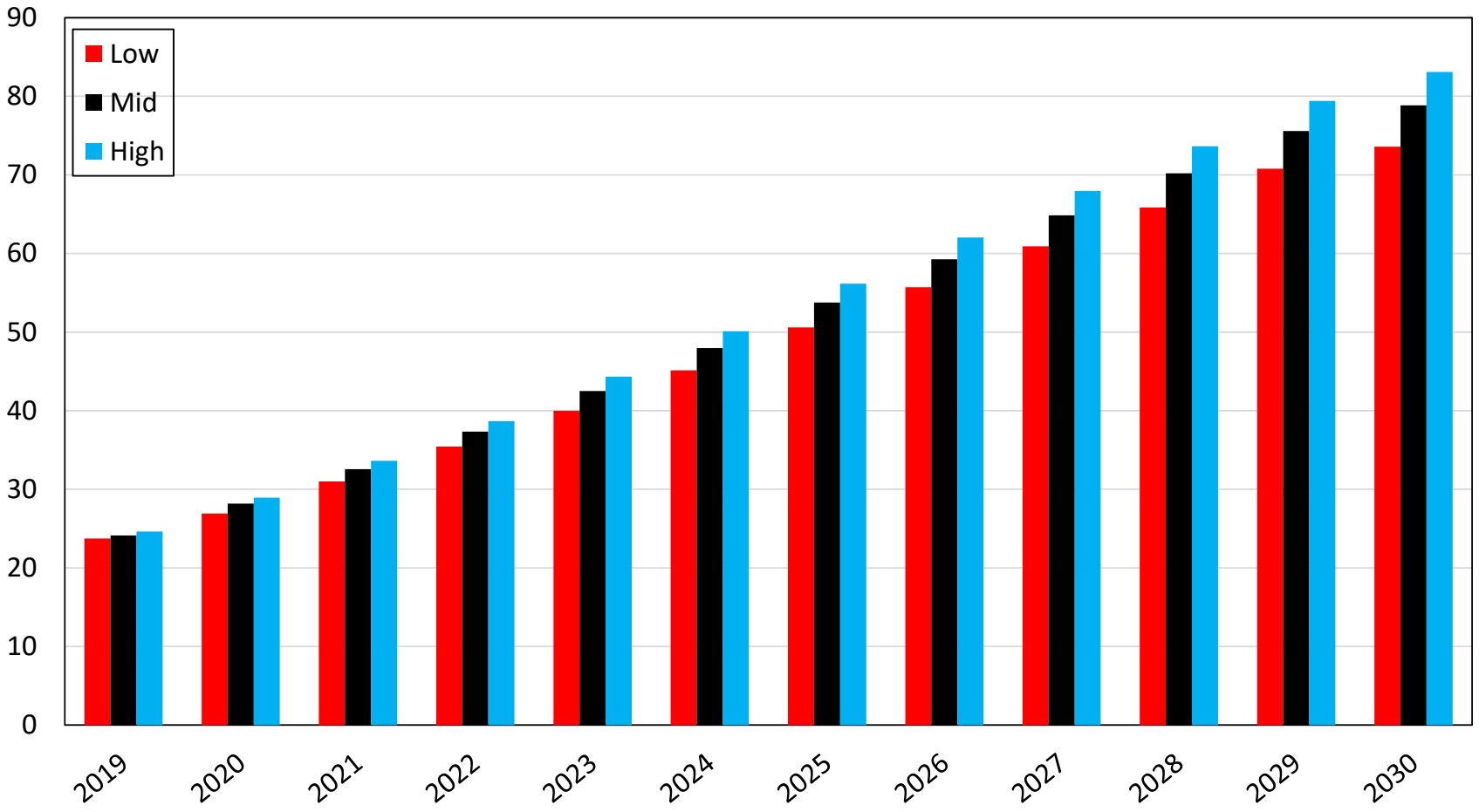
Incentivized Diesel-Electric Hybrid Truck Stock



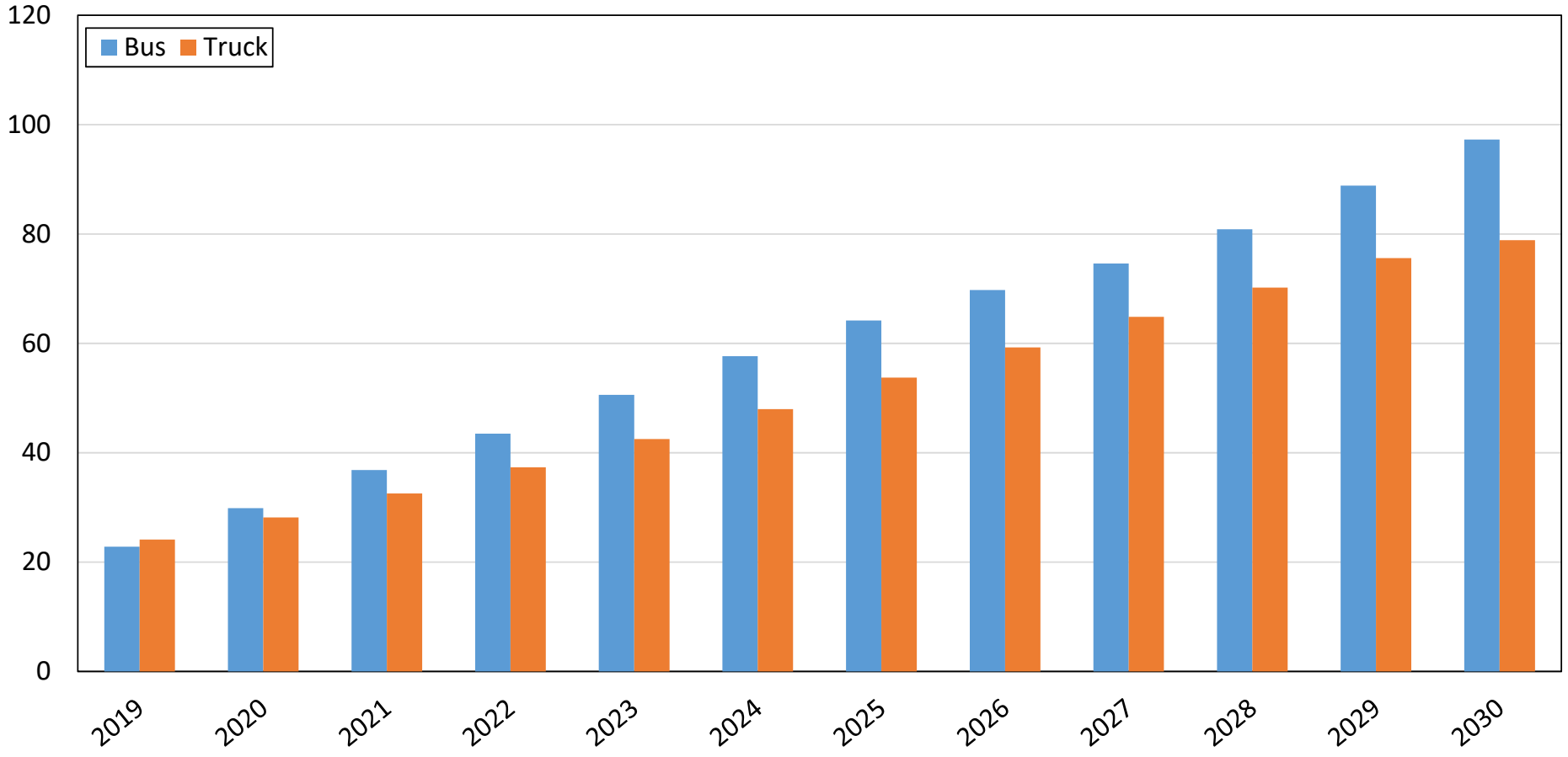
Incentivized Natural Gas Truck Stock



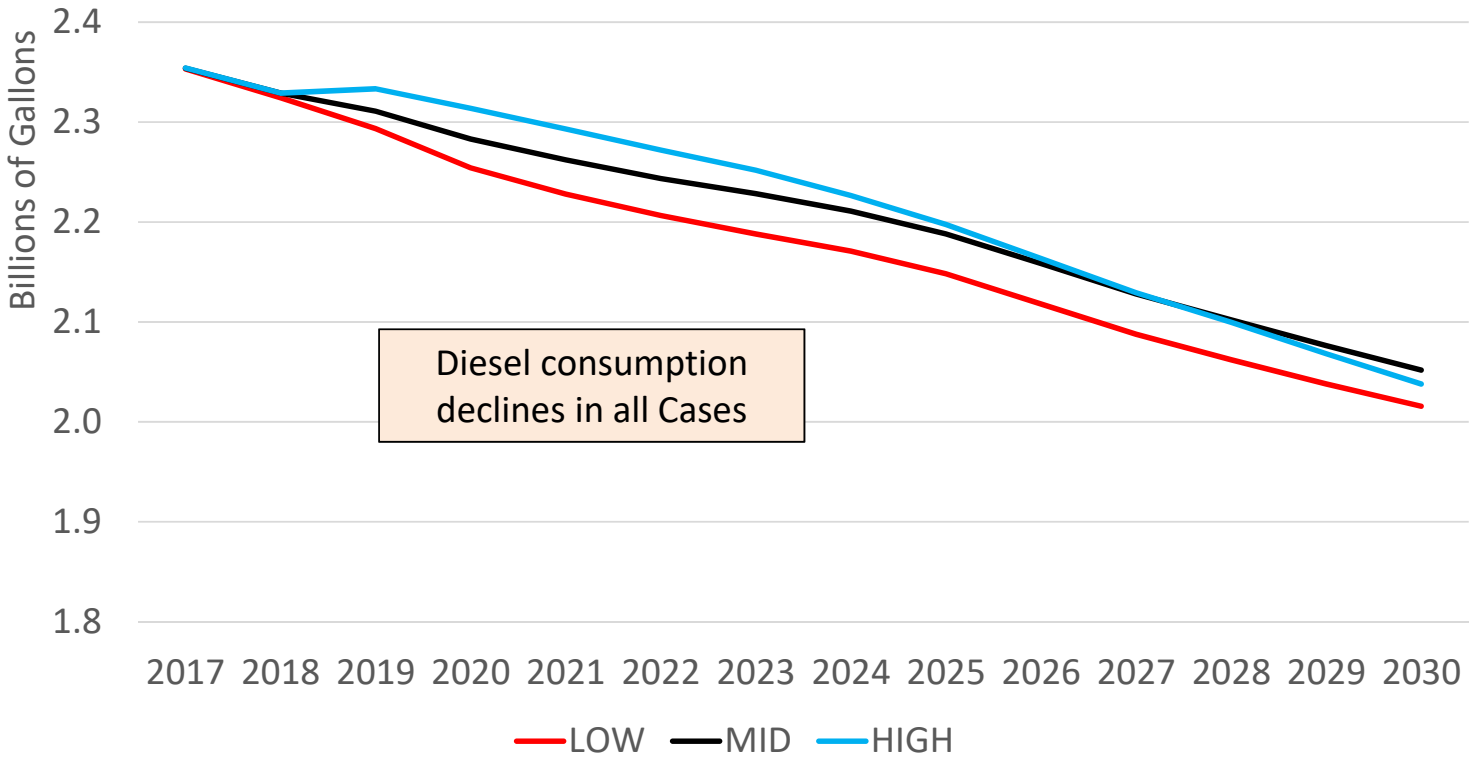
Hydrogen Truck Stock Forecast



Hydrogen Bus & Truck Stock Forecast: Mid Case



Truck Diesel Consumption



Under Consideration for the Revised Forecast

- Incentive levels and duration will be updated
- Update to GSP economic data for activity and service trucks
- Possible inclusion of announced truck prices as an Aggressive or Bookend case
- Revisit battery prices for battery-electric trucks
- More?

Questions?
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