

# Electric Vehicle and Robotaxi in California

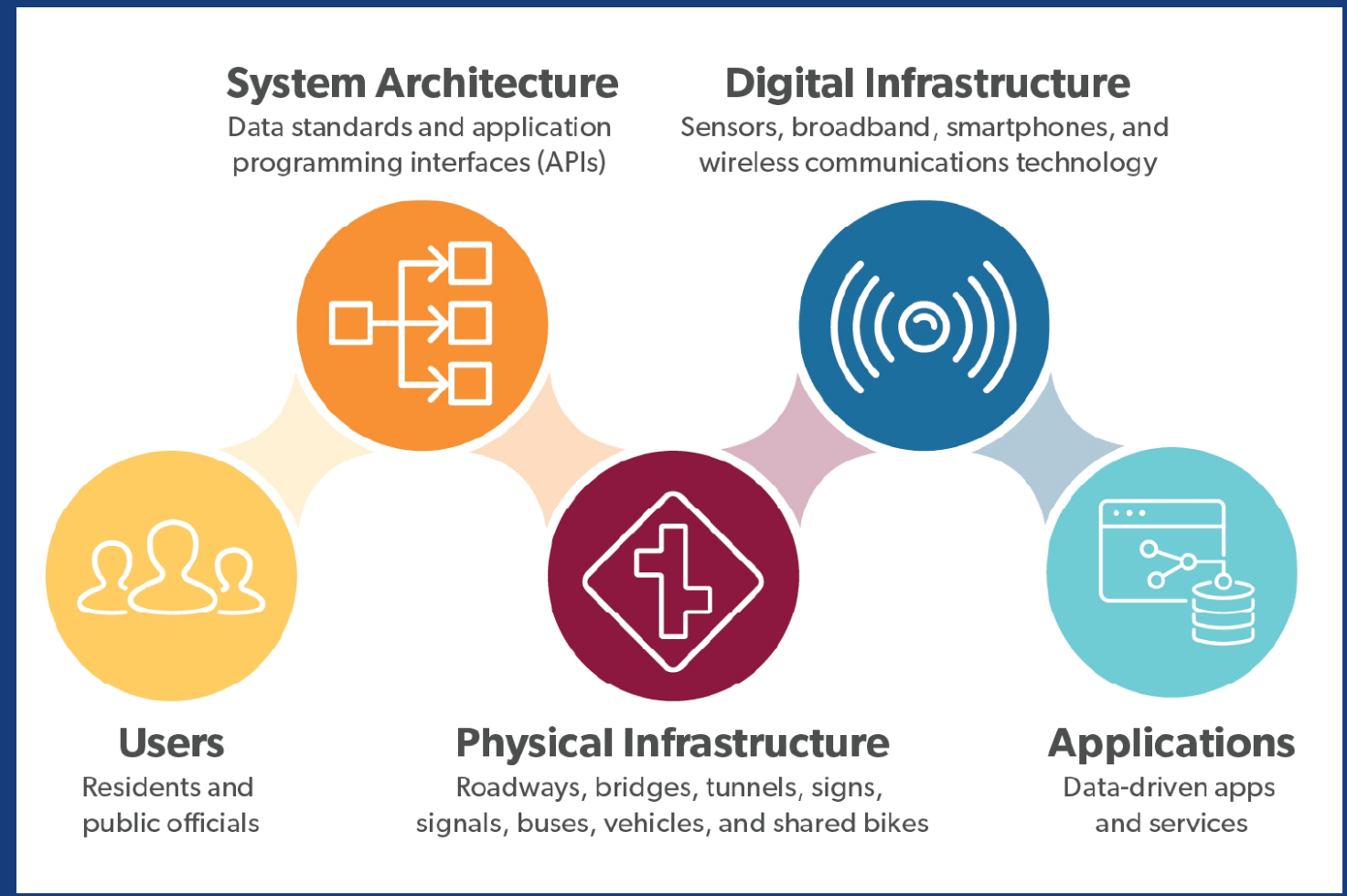
*Cheol-Ho Lee*  
SCAG



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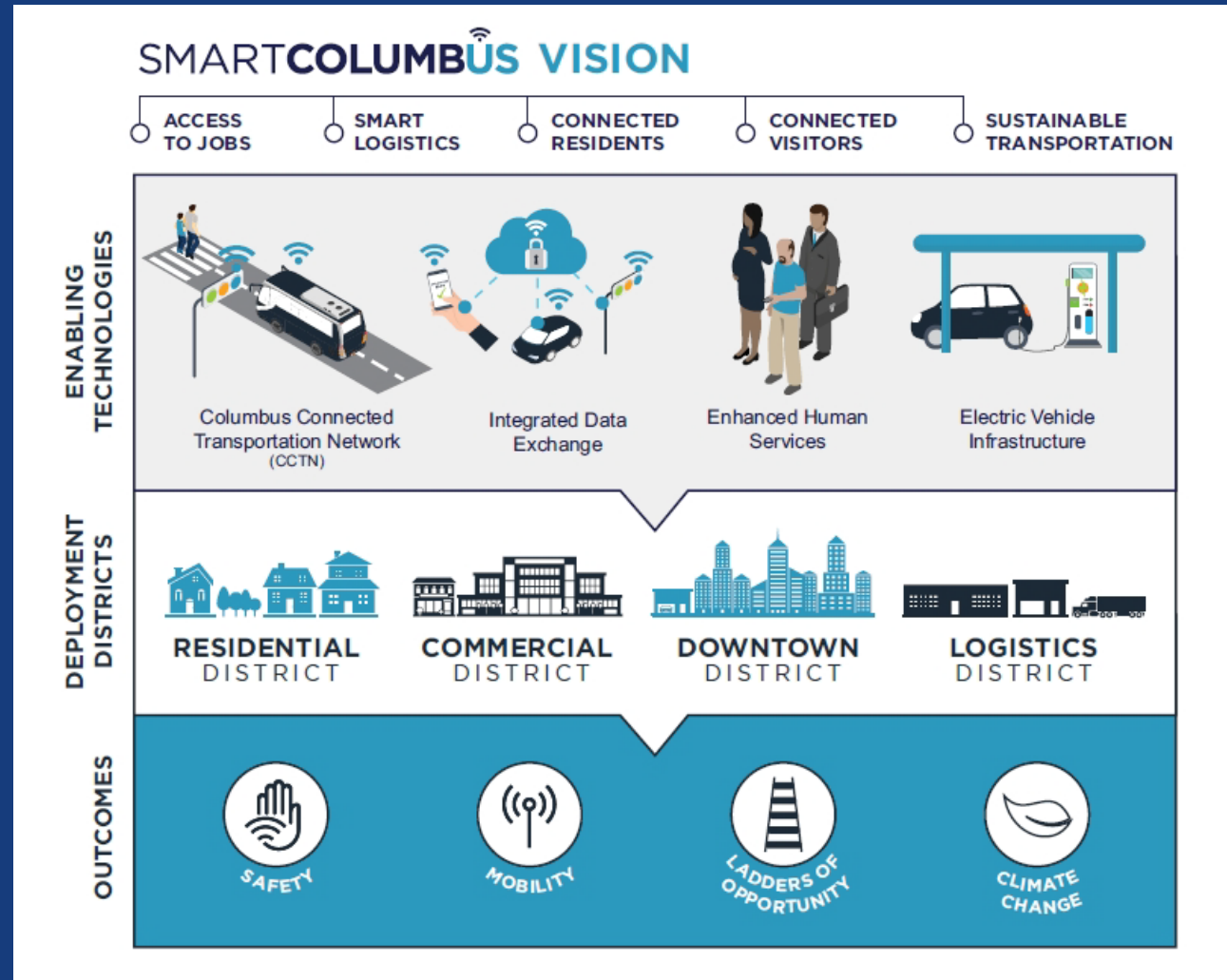
- **Concept of Smart City in Policy Perspective**
- **Expansion of Electric Vehicle in California**
- **Current Status and Prospects of Robotaxi in California**

# Smart Cities and Communities (SC&Cs)



Source: USDOT, Smart Cities and Communities

# Smart City Challenge



Source: USDOT, Smart City Challenge



# Smart Grant Program

- **Strengthening Mobility and Revolutionizing Transportation.**
- **2021, Sec. 25005 of the Bipartisan Infrastructure Law (BIL).**
- **\$100M annually for fiscal years 2022–2026.**
- **SMART Grants Program will fund projects that focus on using technology interventions.**
- **Coordinated Automation / Connected Vehicles / Intelligent, Sensor-based Infrastructure / Systems Integration / Commerce Delivery and Logistics / Leveraging Use of Innovative Aviation Technology / Smart Grid / Smart Technology Traffic Signals**

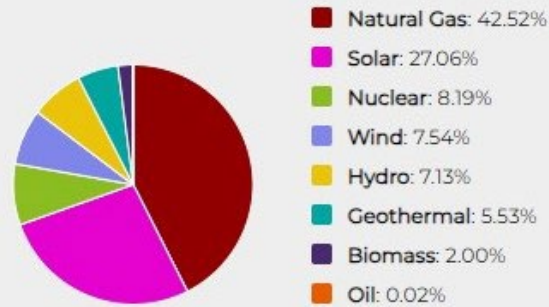
# Benefits of SC&Cs

	<p>SC&amp;C solutions support safer and healthier communities by improving traffic safety and emergency response, improving access to health care, supporting active modes of transportation, and identifying and addressing emissions hot spots.</p> <p><b>HEALTH AND SAFETY</b></p>	<p><b>EQUITY</b></p>
	<p>SC&amp;C solutions are leading the way to a zero-emissions future by improving traffic flows, installing electric vehicle infrastructure, and converting public fleets and buses to electric vehicles.</p> <p><b>CLIMATE CHANGE</b></p>	<p>SC&amp;C solutions increase access to opportunity by making technologies more accessible and affordable; improving access to broadband and wireless services; connecting underserved communities to employment, amenities, and services by providing affordable, reliable transportation options; and bridging the digital divide.</p>
	<p>SC&amp;C solutions provide new pathways and platforms for citizen engagement by creating open-data portals; breaking down silos; and enabling more responsive, integrated, data-driven municipal services.</p> <p><b>OPEN GOVERNMENT</b></p>	<p><b>MOBILITY</b></p> <p>SC&amp;C solutions support better mobility choices, improving the quality and reliability of transit services, enhancing pedestrian and bicycle infrastructure, and making better use of the space allocated to parking.</p> <p><b>ECONOMIC GROWTH</b></p>

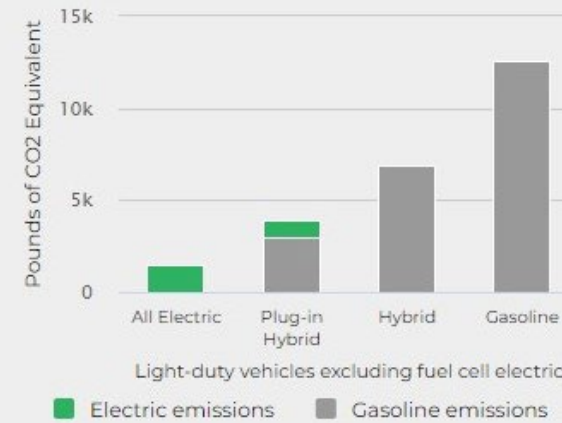
Source: USDOT, Smart Cities and Communities

## State Averages for California

Electricity Sources

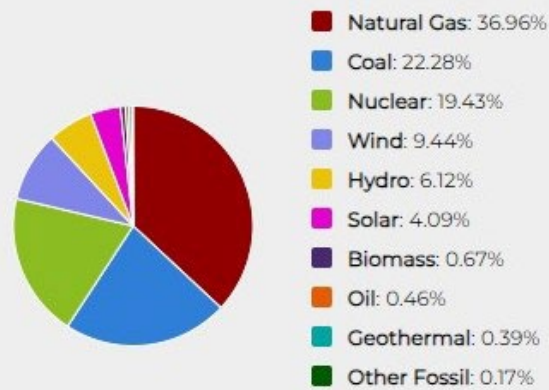


Annual Emissions per Vehicle

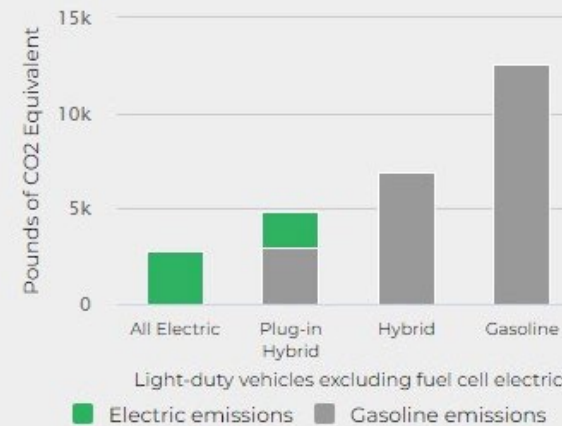


## National Averages

Electricity Sources



Annual Emissions per Vehicle





# Transformation of the Vehicle Market

- **Government and Corporate Policies**
- **National ZEV mandates: California. 12 states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont and Washington)**
- **CAFE standards (corporate average fuel efficiency)**
- **State tax credits**
- **Workplace charging/Preferential access to high occupancy vehicle (HOV) lanes**
- **State legislation**





## Save Even More with Federal, State, Local, and Utility Incentives for EVs and Chargers \*

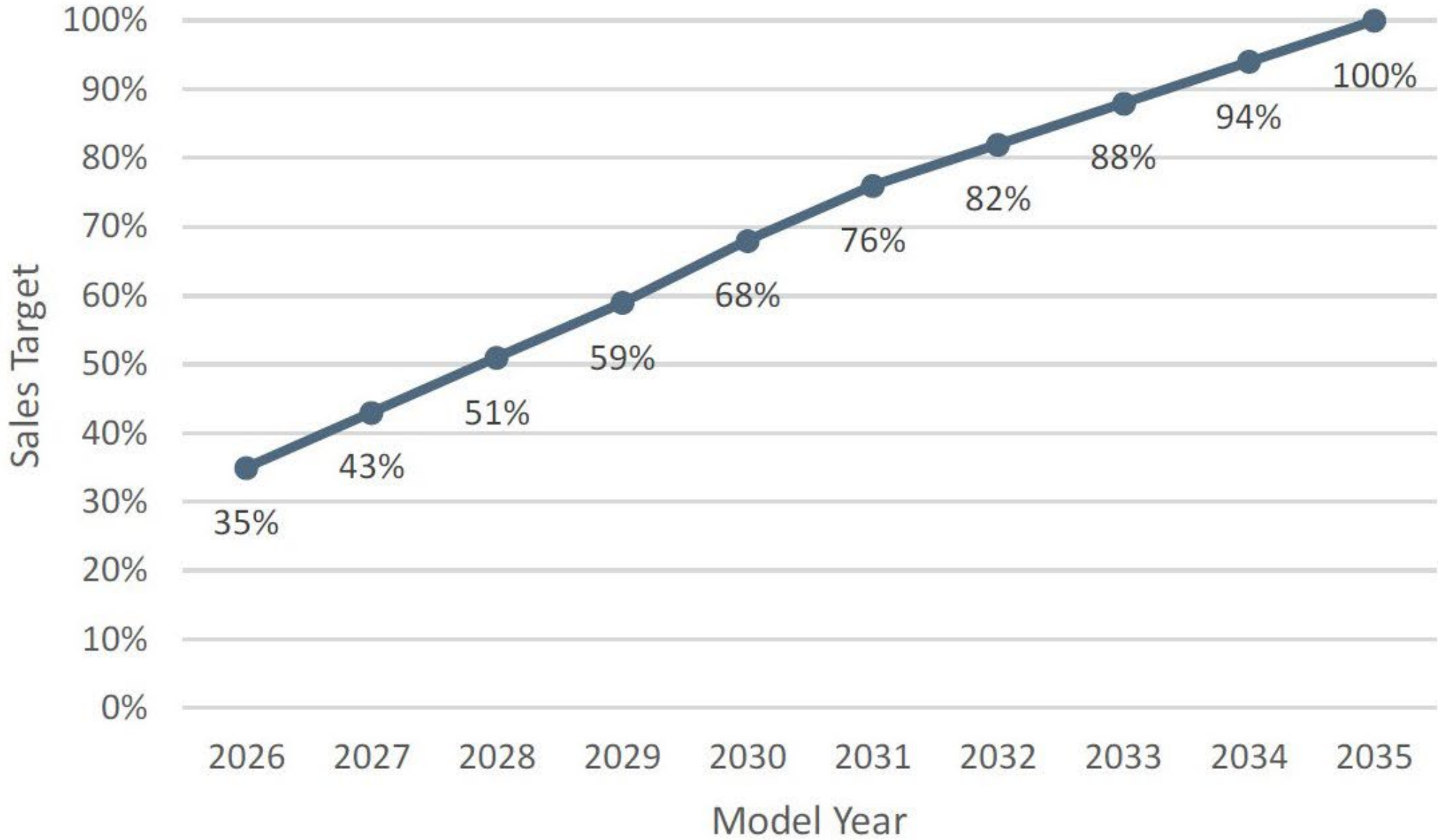
Federal	California State	Southern California Local	California Utility
Federal Tax Credit for Electric Vehicles: \$7,500 (max incentive, varies by manufacturer)	California Clean Vehicle Rebate Project for New EVs: \$2,000 – \$4,500 (income-eligible)	South Coast Air Quality Management District – Replace Your Ride: \$9,500 for New EVs (income-eligible)	All – Special time-of-use rates to reduce the cost of EV charging
	California Clean Fuel Reward for New EVs: \$750	South Coast Air Quality Management District – Residential EV Charging Incentive Pilot Program: \$500	LADWP – Charge Up LA!: Used EVs -\$1,500 Chargers - \$750
			Southern California Edison Pre-Owned EV Rebate: \$1,000 – \$4,000 (income-eligible)

\*As of February 2022, to see a list of all available incentives in your area visit <https://afdc.energy.gov/laws>

# California EV Policy

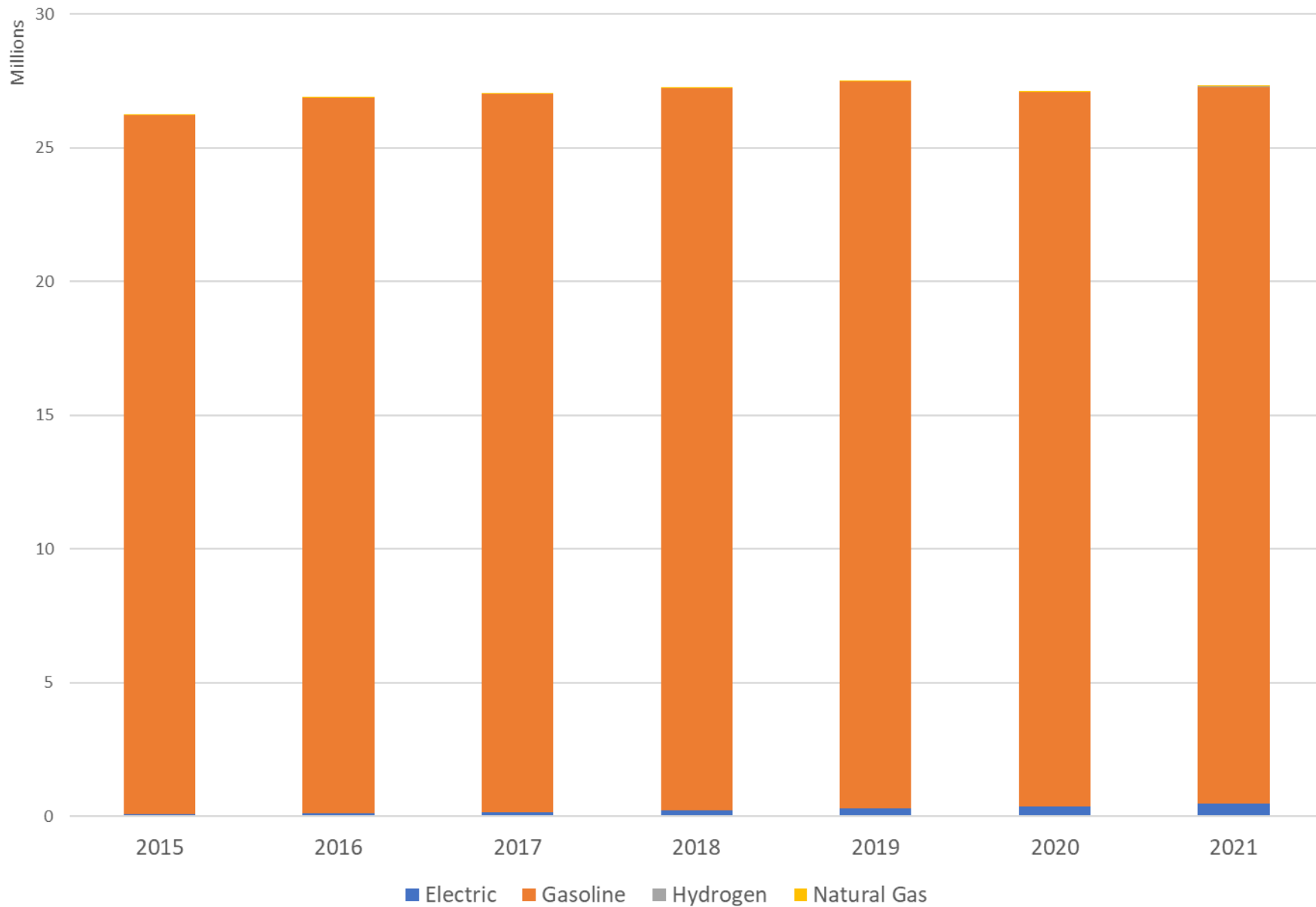


- **Increasing the EV eased burden of GHG reduction: reducing greenhouse gas emissions to 40% below 1990 levels by 2030.**
- **AB 2127(2018): formalized the State's goal to have 5 million ZEVs on the road by 2030.**
- **Governor Gavin Newsom Executive Order N-79-20(2020): increase AB 2127's target to 8 million EVs by 2030. accelerate to 100% new zero-emission vehicle sales by 2035**
- **California Air Resources Board (CARB) Advanced Clean Cars II (ACC II) rule: requiring vehicle manufactures to sell an increasingly higher percentage of zero-emission vehicles (ZEVs). 100% of new light-duty vehicle sales are zero-emission in March, 2035.**





## Registered Vehicles by Fuel Type in CA



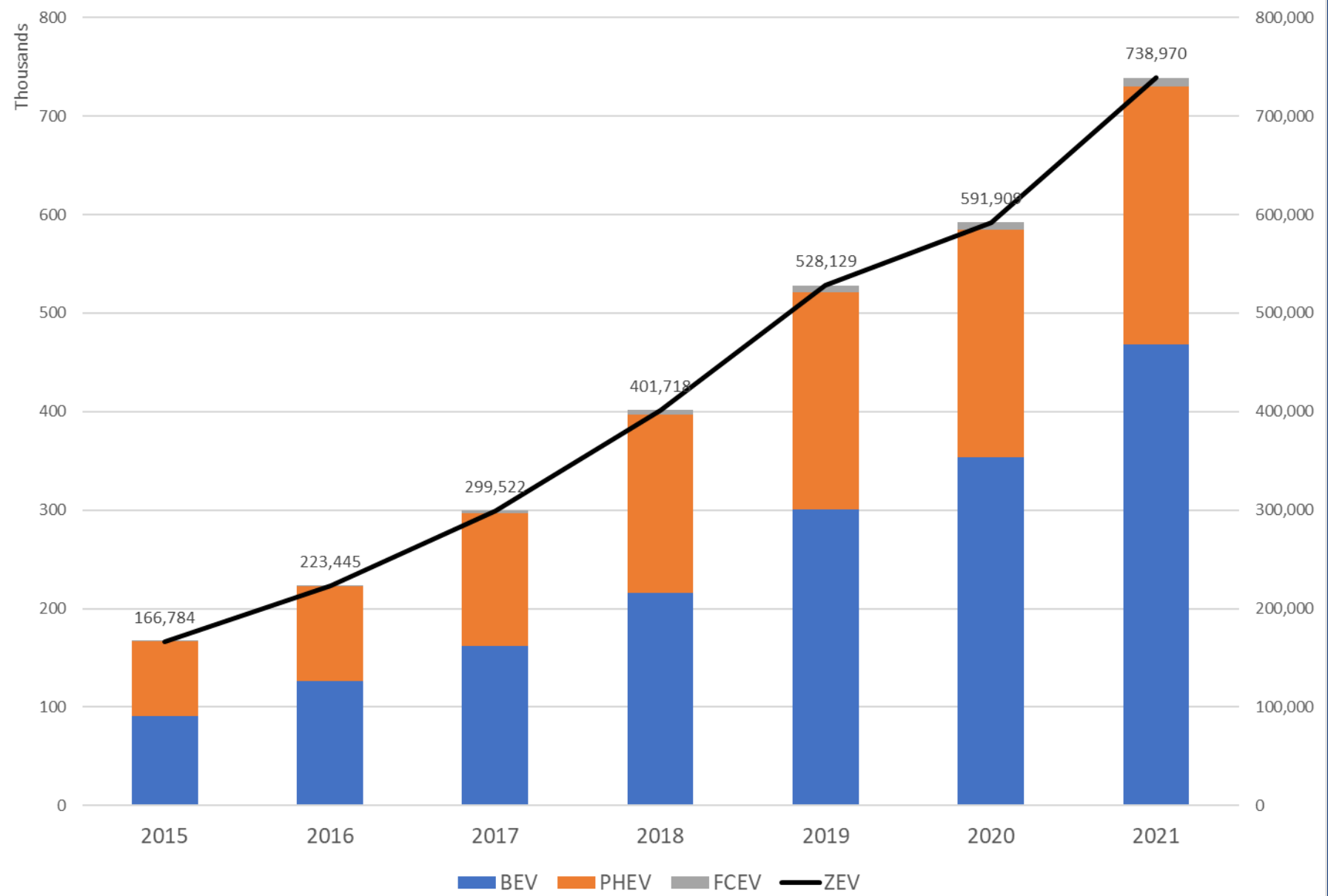


### Growth of Registered Vehicles by Fuel Type in CA





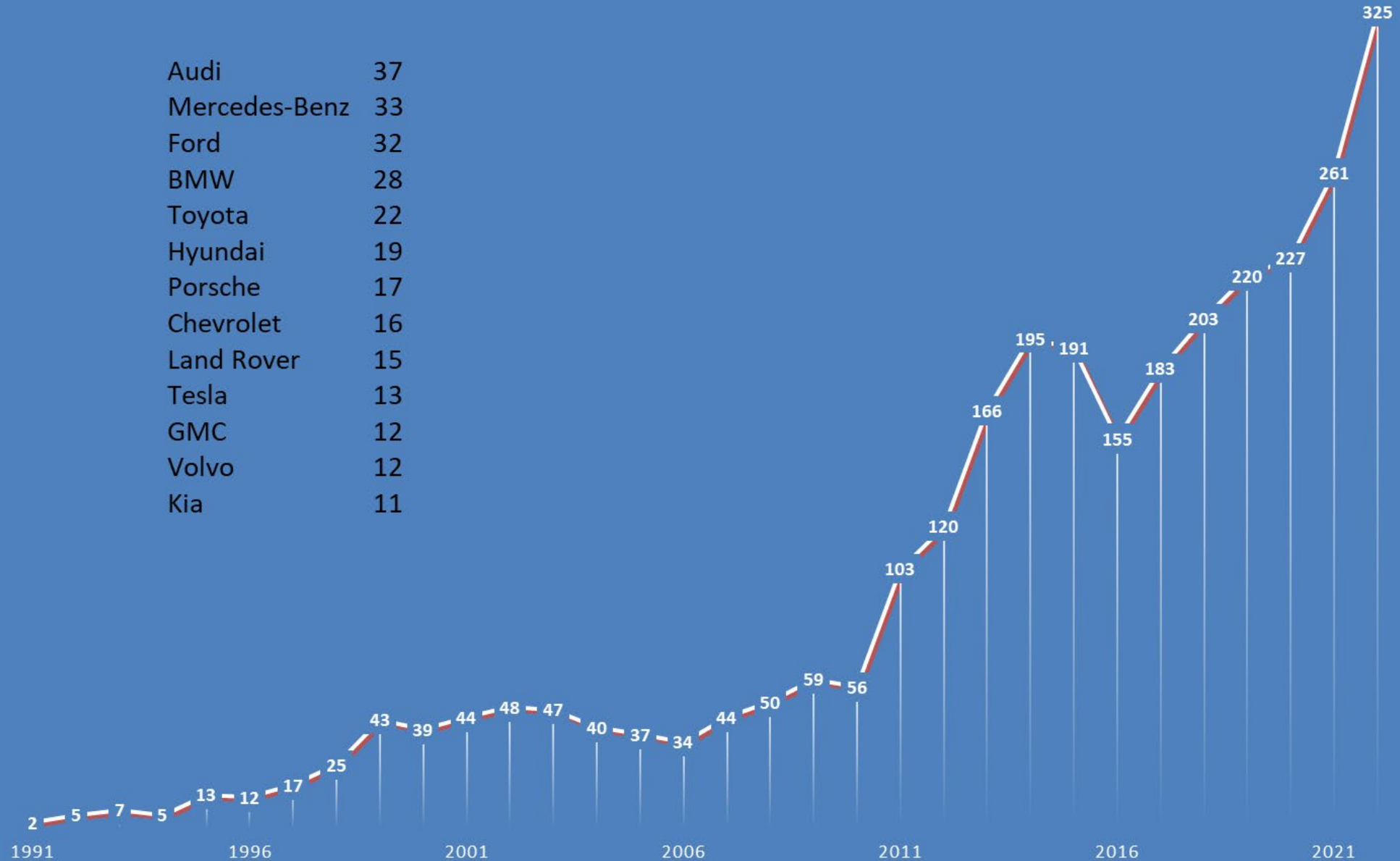
### Registered Vehicles by Fuel Technology in CA



# AFV/HEV



Audi	37
Mercedes-Benz	33
Ford	32
BMW	28
Toyota	22
Hyundai	19
Porsche	17
Chevrolet	16
Land Rover	15
Tesla	13
GMC	12
Volvo	12
Kia	11





# Benefits and Risks

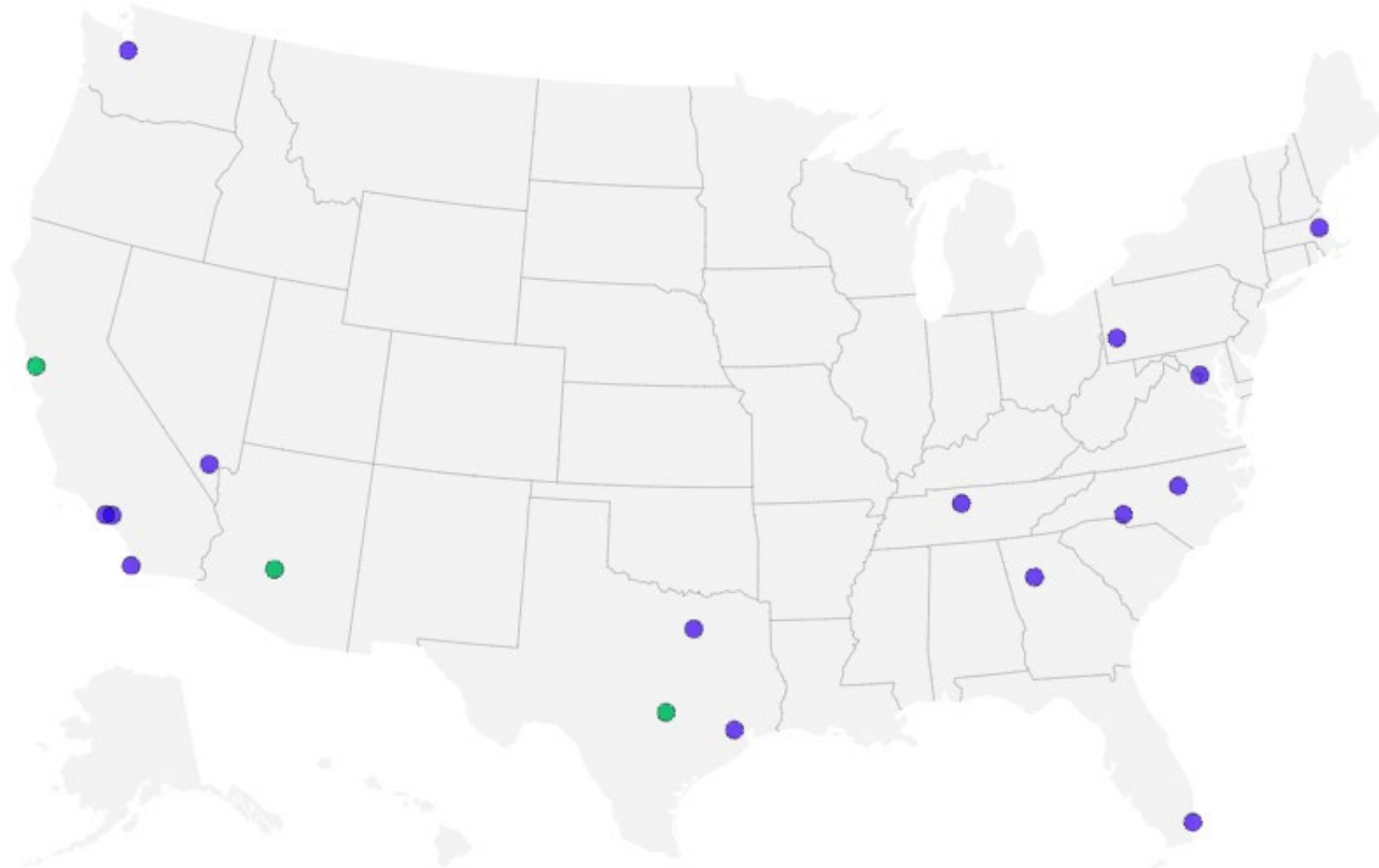
- **Benefits**
  - **Reducing GHG emissions**
  - **Benefits of innovative technologies and related economic development activities**
- **Potential risks**
  - **Building the charging stations**
  - **Technological obsolescence of certain EVSE(electric vehicle supply equipment)**



# Robotaxi rollout, by city

As of Aug. 28, 2023

Operational Testing



Data: Axios Research; Graphic: Rahul Mukherjee/Axios



# History of Autonomous Vehicle (AV) and Robotaxi



- **September 2016 - Uber started allowing a select group of users in Pittsburgh, Pennsylvania.**
- **April 2017 - Waymo started a large scale robotaxi tests in a geo-fenced suburb of Phoenix, Arizona.**
- **December 2018 - Waymo started self-driving taxi service in Arizona.**
- **February 2021 - Waymo began limited robotaxi service in San Francisco.**
- **February 2022 - Cruise opened up its driverless cars in San Francisco to the public.**
- **February 2022 - California Public Utilities Commission (CPUC) issued Drivered Deployment permits to Cruise and Waymo to allow for passenger service in autonomous vehicles.**
- **Aug. 10, 2023 - CPUC allowed Waymo and Cruise to take paying passengers day or night throughout San Francisco.**



Company	2021		2022		
	FREQ	Driver	FREQ	Driver	Mileage
AIMOTIVE INC.	106	-	680	-	
APOLLO AUTONOMOUS DRIVING USA LLC	1	1			21,773.87
APPLE INC.	663	-	5,982	-	
ARGO AI, LLC	1	-	1	-	
AURORA OPERATIONS, INC.	9	-	-	-	
AUTOX TECHNOLOGIES, INC	1	-	1	-	
CRUISE LLC	21	-	9	5	546,492.42
DEEPROUTE.AI	2	-			
DIDI RESEARCH AMERICA LLC	1	-	2	-	
EASYMILE	222	-	-	-	
GATIK AI INC.	6	-	3	-	
GHOST AUTONOMY INC	-	-	448	-	
IMAGRY INC.	71	-	204	-	
LYFT	23	23	-	-	
INTEL CORPORATION			155	-	
MERCEDES-BENZ RESEARCH & DEVELOPMENT NORTH AMERICA, INC.	272	-	38	-	
MOTIONAL AD, INC.	-	-	135	135	
NISSAN NORTH AMERICA, INC DBA ALLIANCE INNOVATION LAB	17	17	8	8	
NURO, INC	23	-	15	-	924.19
NVIDIA	82	-	7	-	
PONY.AI, INC.	21	-	20	-	
QCRAFT INC.	5	-	3	-	
QUALCOMM TECHNOLOGIES, INC.	143	-	128	-	
TOYOTA RESEARCH INSTITUTE, INC.	419	-	112	-	
UDELV, INC.	46	46	-	-	
VALEO NORTH AMERICA INC.	205	-	71	-	
WAYMO LLC	292	-	170	-	51,639.20
WERIDE CORP	3	1	3	3	
ZOOX, INC	21	-	21	-	

## Disengagement of AV testing



Cruise: GM



Waymo: Alphabet (Google)  
"a new WAY forward in MObility"



# Facts of Robotaxi

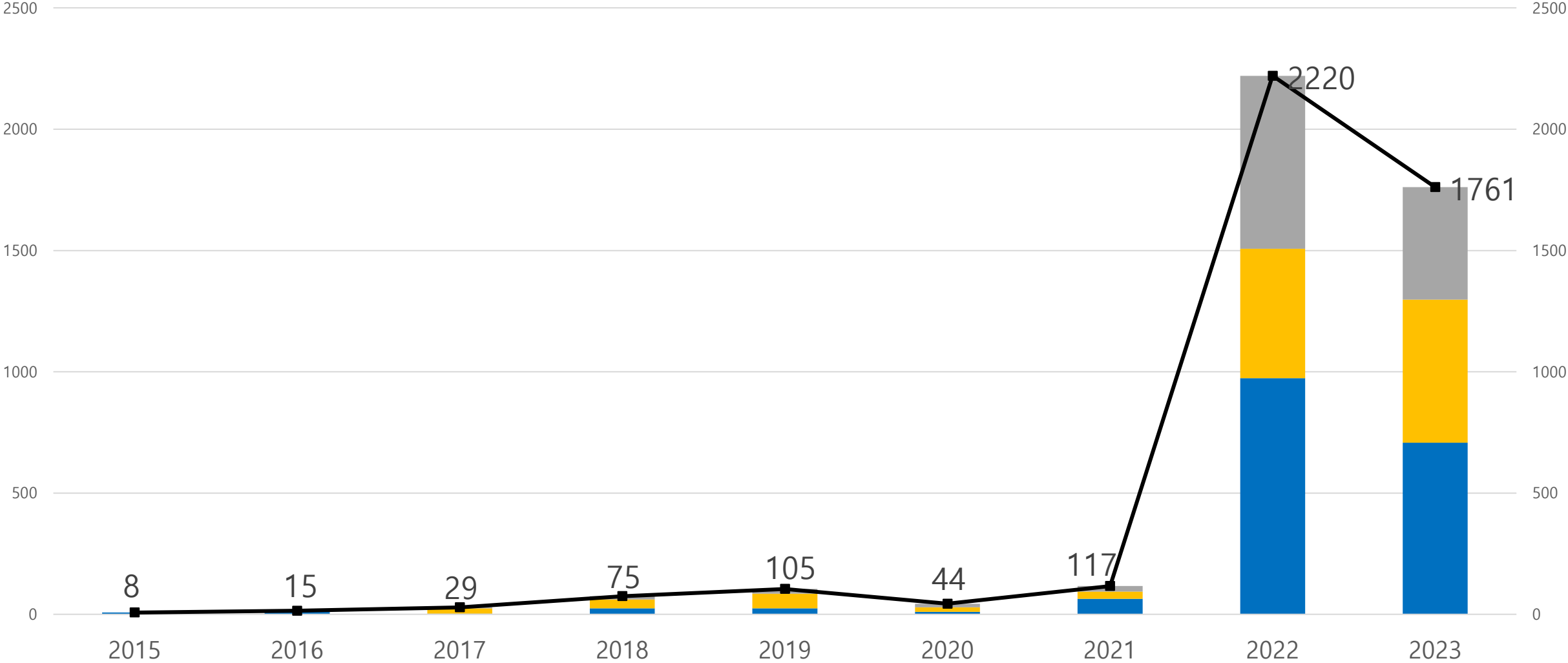
- **Operational: Phoenix, San Francisco and Austin**
- **Testing: 14 cities(Seattle, San Diego, Miami, Nashville, Raleigh, Charlotte, Atlanta, Washington, D.C. Dallas, Houston, Los Angeles, etc.)**
- **Congress has yet to pass AV legislation despite efforts since 2017**
- **23 states have passed laws allowing AV testing and/or deployment.**

# Robotaxi in San Francisco



- **Waymo currently operates 250 while Cruise operates 300 at night and 100 during the day in San Francisco.**
- **Waymo permitted to drive at speeds of up to 65 miles per hour, while Cruise limited to 35 miles per hour.**
- **Ride fare is about regular Uber/Lyft.**
- **Cruise and Waymo cars have been involved in a number of traffic incidents throughout San Francisco streets - ranging from a wayward robotaxi rolling into wet cement to more serious incidents involving emergency vehicles.**
- **August 19, 2023, Cruise agreed to a 50% reduction after two incidents (pedestrian / fire truck).**
- **October 2, 2023, Cruise involved in an accident (pedestrian).**
- **October 24, 2023. California DMV has suspended driverless vehicles operated by the Cruise in San Francisco.**

# AV Collision



Waymo Cruise Others Total

source: CA DMV



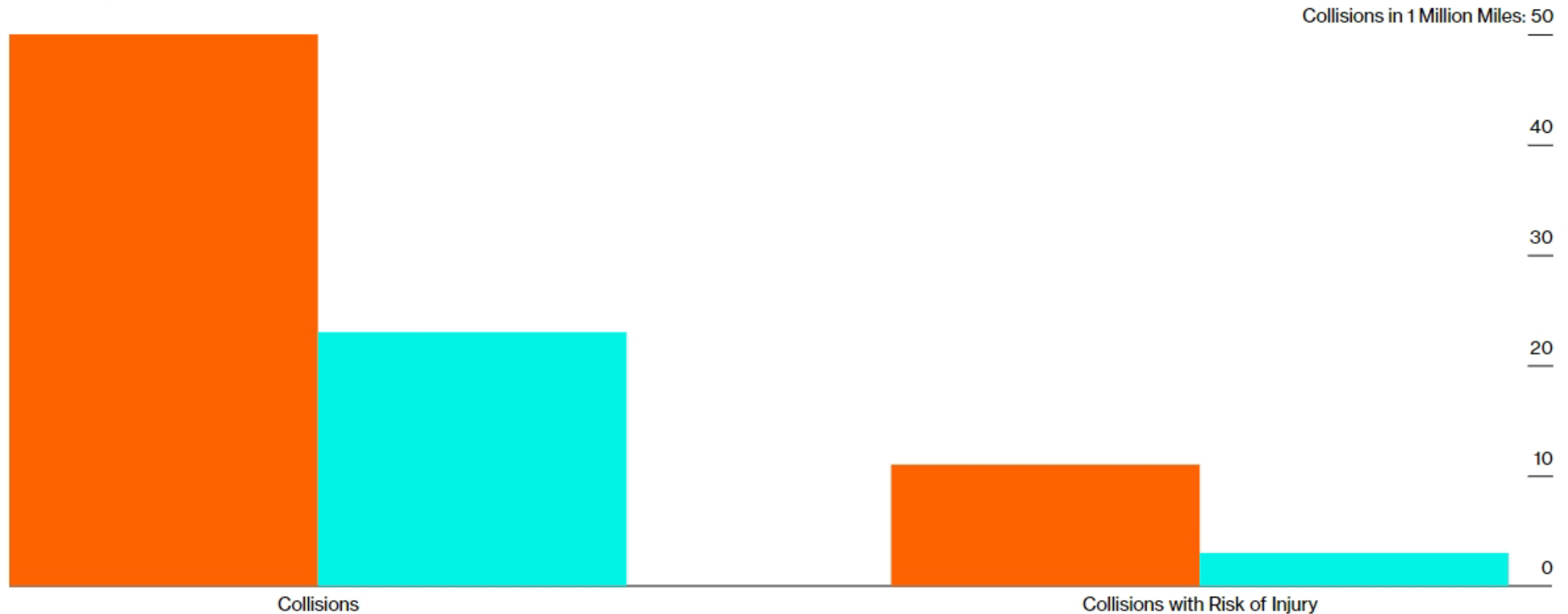
## Pros and Cons - Robotaxi

- **Safer: less collision, less collision with risk of injury**
- **Lower Price: much more affordable than Uber and Lyft fares.**
- **Less Pollution.**
- **Solving Parking Problems.**
- **Boost advanced technology.**
- **Fails: yield to pedestrians, block up intersections, and park in bus stops, crosswalks and bike lanes.**
- **Environment issues: mining of lithium and cobalt for batteries.**
- **Losing Jobs**
- **Erode Public Transit Utilization**



## Robotaxis Outperform Humans in San Francisco, Cruise Data Suggests

■ Approximated Human Ride-hail Driver ■ Cruise Driverless Vehicle



Source: Cruise, University of Michigan Transportation Research Institute, Virginia Tech Transportation Institute

Data comes from preliminary study results published by Cruise. Collisions with risk of injury are defined as vehicle collisions "requiring application of medical examination and treatment."





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