

**Electric Vehicles**  
**Sustainable Cities Network SEE Workgroup**  
**and EV Subgroup Meeting**  
**8/10/21**

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# Topics



EV  
background

EVs in  
Arizona

What are  
other cities  
doing?

Statewide TE  
plan

# Typical Ranges of EVs – BEV and PHEV

## Battery Electric Vehicle (BEV)

- 100% electric motor and grid charged battery – no gasoline
- Range 80 to 350 miles



## Plug-in Hybrid Electric Vehicle (PHEV)

- Electric motor and grid charged battery + internal combustion engine
- Range 10 to 50 miles on battery + 300-800 miles on gasoline



3.5 kWh = 10 miles  
of range on average

## Three Charging Levels, 4 Charging Connectors

### Level 1 - home

- 120 V, 1-Phase AC
- Less than 2 kW
- 2-5 miles of range per hour of charging



**J1772 basic charging connector** comes with all EVs – works with all 120V (level 1) and 240V (level 2) stations



## Three Charging Levels, 4 Charging Connectors

### Level 2 – home & public

- 208/240V, 1-Phase AC
- 2-19.2 kW
- 10-20 miles of range per hour of charging

J1772 connector on **all EVs**.  
Charges level 1 and level 2, Tesla with adapter



Can be hardwired or 240 outlet  
such as a dryer plug

## Three Charging Levels, 4 Charging Connectors

### Level 3 DC Fast Charge – Public

208/480V, 3-Phase

- 24 to 1000 kW
- 60-80 miles of range per 20 minutes of charging

3 DCFC Connectors based on vehicle type

Tesla



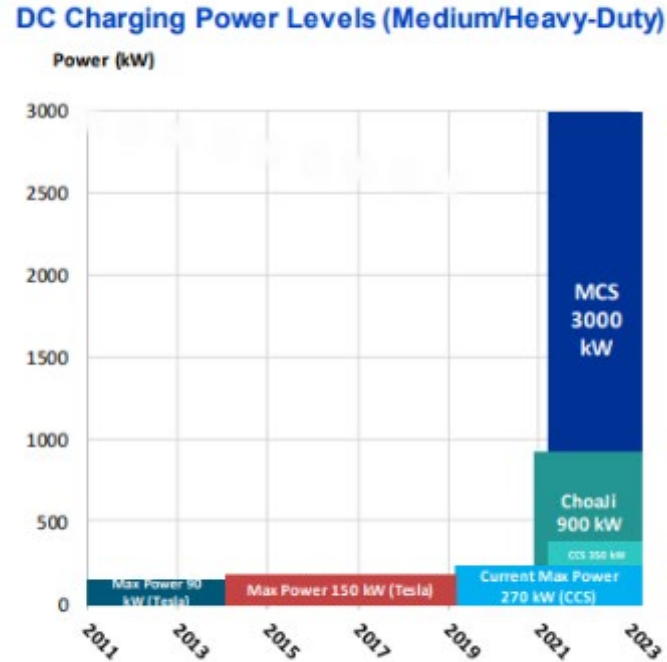
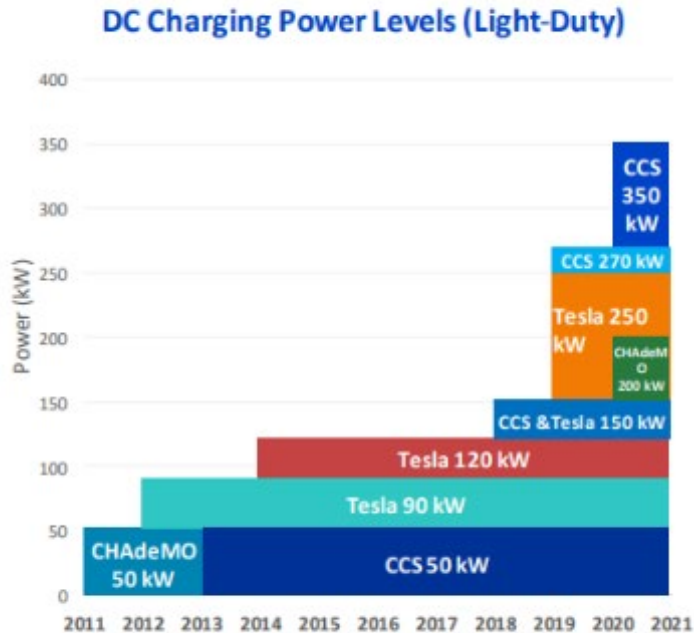
Chademo



CCS – or combo connector



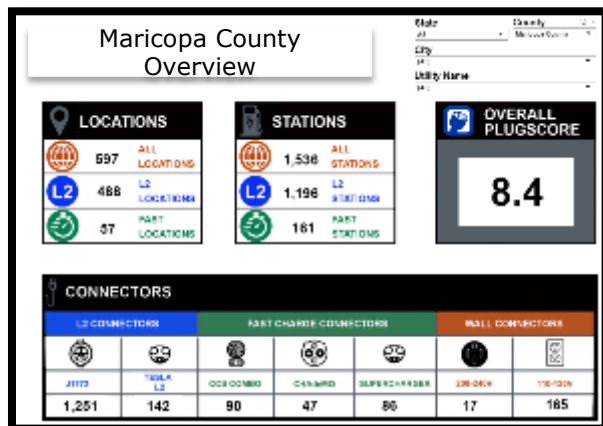
# DC fast charging power levels



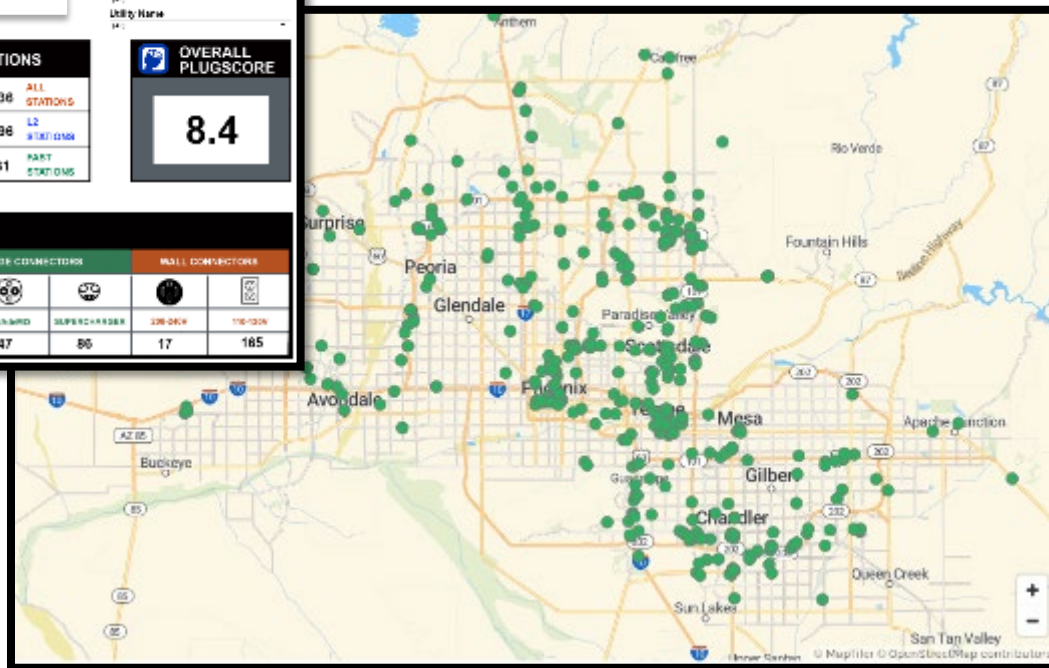
Source EPRI  
2021



# Where are the public charging stations?



Source: Plug share



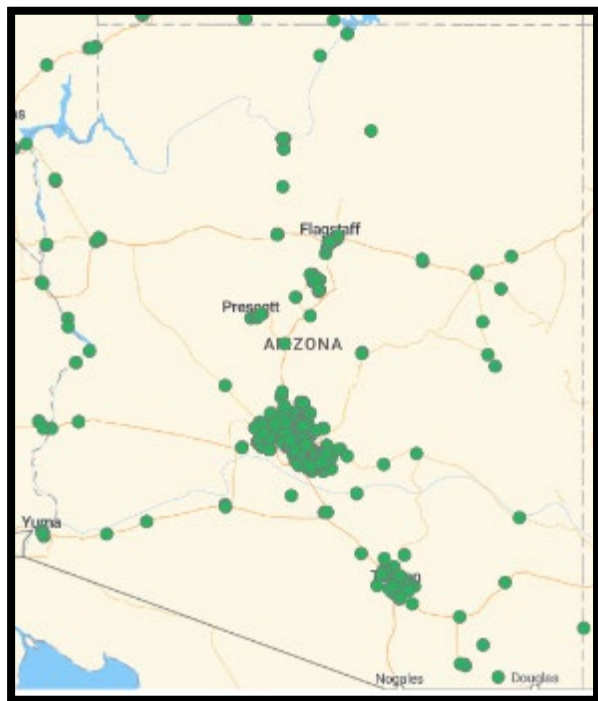
Source: Alternative Fuels Database

Stations		
City	Level 2	DCFC
Phoenix	396	48
Scottsdale	212	31
Tempe	203	11
Chandler	134	9
Mesa	61	5
Gilbert	46	6
Glendale	34	11
Surprise	20	0
Peoria	18	1
Avondale	12	0
Cave Creek	10	0
Goodyear	8	0
Queen Creek	7	0
Litchfield Park	5	0
Tolleson	4	0
Buckeye	2	12
Sun City	0	0
Maricopa	0	0
Apache Junction	0	0
Laveen	0	0

Source: Plug share

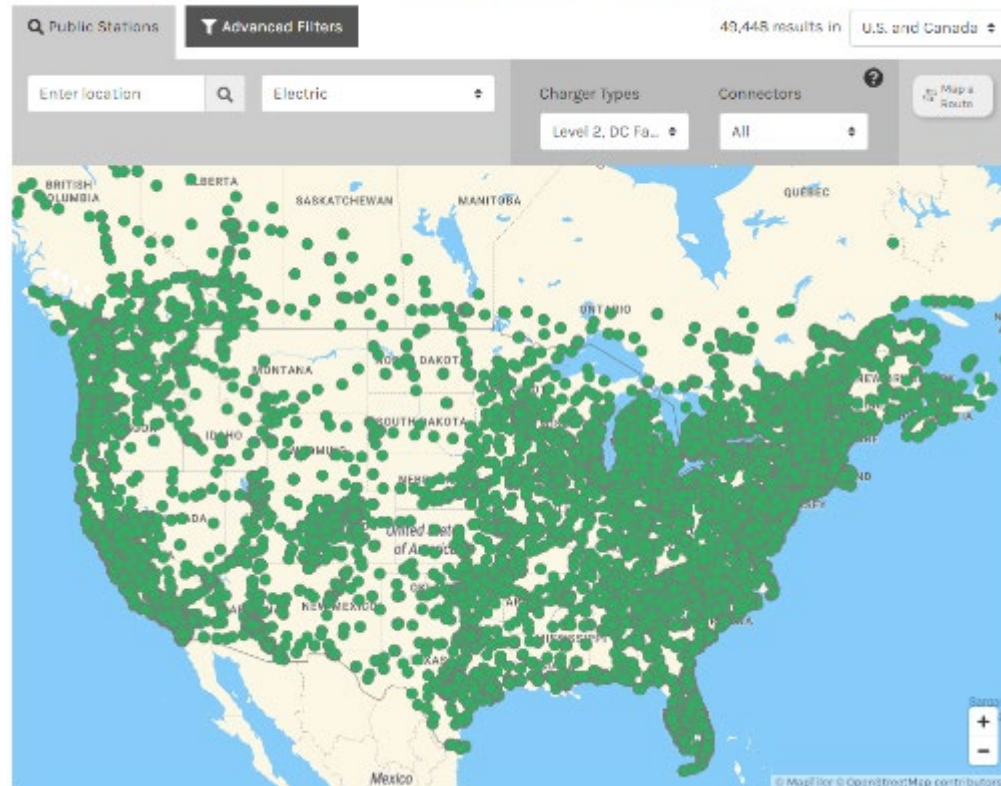


# Where are the public charging stations?



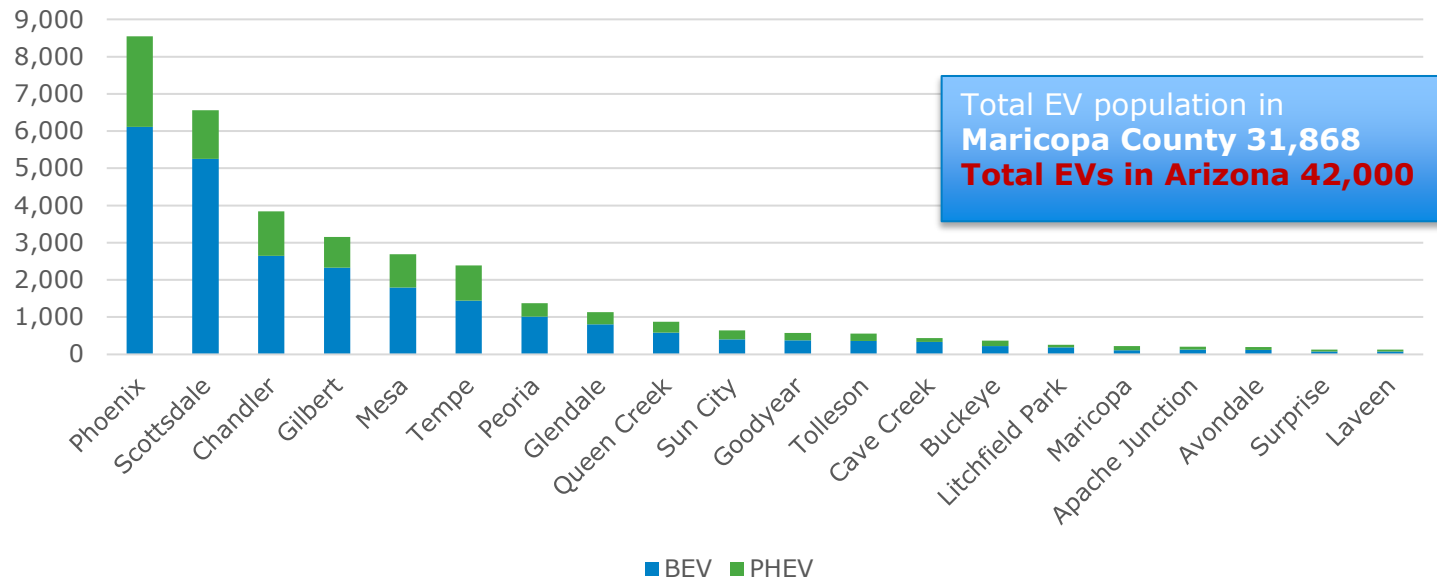
## Electric Vehicle Charging Station Locations

Find electric vehicle charging stations in the United States and Canada. For Canadian stations in French, see [Natural Resources Canada](#)



# Where are the EVs Located?

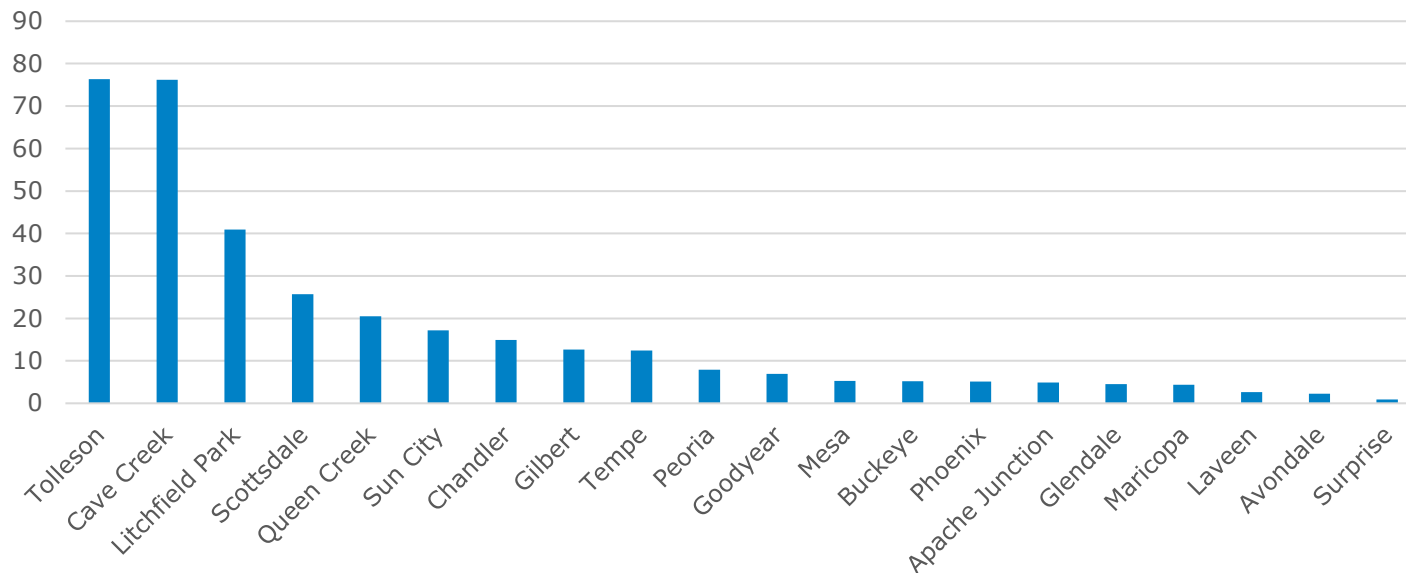
EV Registration Maricopa County top 20 Cities January 2021  
– Top 20 Cities



Source: EPRI 2021

# That doesn't tell the whole story

EVs PER 1,000 POPULATION January 2021

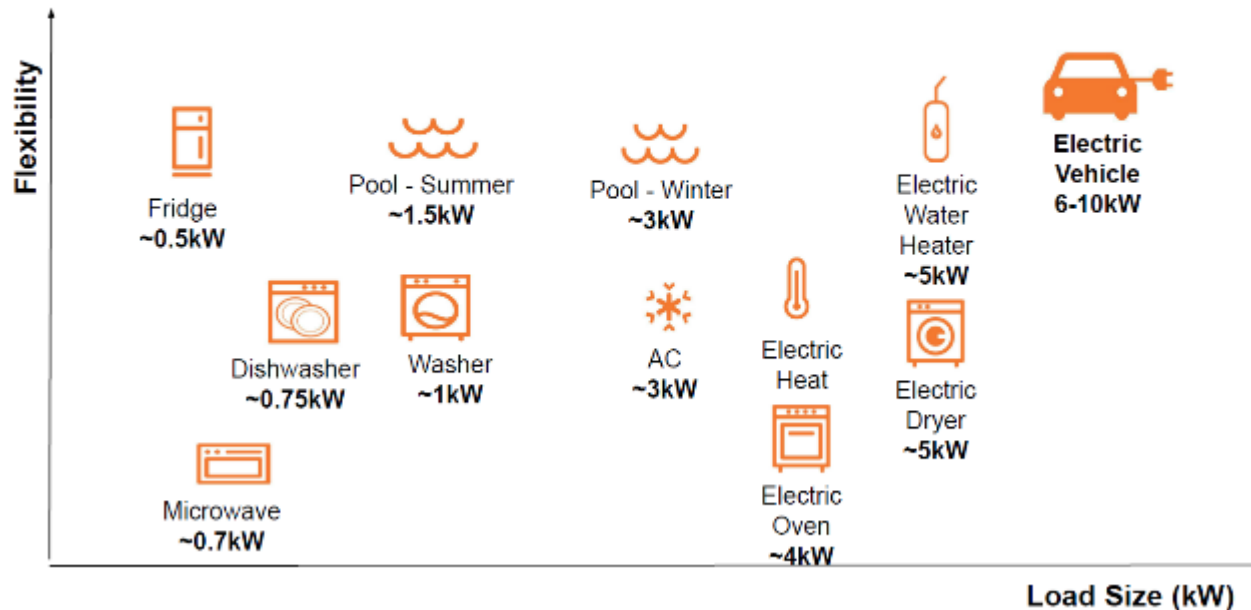


Source: EPRI 2021

# What do light duty EVs mean to the Grid?

## An EV on the grid

A Large & Highly Flexible Load



# Commercial electric and fleet vehicle options also expanding

BUSINESS

## Amazon unveils prototype of Rivian-built electric delivery van

Robert Channick / Chicago Tribune

Published 10:15 p.m. ET Oct. 4, 2020

[View Comments](#)



Your Amazon package may be arriving in a custom-built Rivian electric delivery vehicle by next year.

Amazon unveiled a prototype Thursday of one of three electric vehicles being developed in partnership with Plymouth-based EV truck manufacturer Rivian. The online retail giant expects to have 10,000 of the Rivian electric delivery vans on the road worldwide by 2022, ramping up to the full 100,000 order by 2030.



Rivian's vans made by Rivian are expected to be making deliveries for Amazon by next year, Amazon



# More big EVs

- School busses
- Transit busses
- Delivery vehicles
- Garbage trucks
- Ferries
- Mining equipment
- Construction equipment
- Aviation



EPRI 2021



# How are cities funding across the US?



DOT Funding and Financing Programs with EV Eligibilities\*

PROGRAM	1	2	3	4	5	6
1. Construction and installation of EV charging infrastructure, including parking facilities and utilities						
2. Software, maintenance and training activities for electric vehicles						
3. EV operations and maintenance with electric vehicles						
4. Passenger EV charging infrastructure and related projects						
5. Construction and installation of EV charging infrastructure to support operations, including software development, security, maintenance and training, and other EV-related activities						
6. Installation of EV charging infrastructure to support operations, including software development, security, maintenance and training, and other EV-related activities						
PROGRAM	1	2	3	4	5	6
<b>TOTAL ALLOCATED PROGRAMS</b>						
National Highway Performance Program (NHPP)	\$25.1 B					
National Transportation Block Grant Program (NTBGP)	\$16.2 B					
Congestion Mitigation and Air Quality Improvement Program (CMAQ)	\$2.4 B					
National Highway Freight Program (NHFP)	\$1.3 B					
State Planning and Research (SPR)	\$641.5 M					
Metropolitan Planning (MP)	\$337.8 M					
<b>DISCRETIONARY PROGRAMS</b>						
Revolving American National Urban and Rural Mobility and Transportation (RUMT)	\$1.0 B					
Infrastructure for Rebuilding America (IRBA)	\$666.0 M					
Advanced Transportation and Congestion Management and Technology Deployment (ATCMTD)	\$10.3 M					
<b>OTHER ALLOCATED PROGRAMS</b>						
Federal Lands and Tribal Transportation Program (FLTTP)	\$1.0 B					
Highway Infrastructure Program (HIP)	\$644.2 M					
Ports and Airway Program (PAAP)	\$11.8 M					
Territorial Highway Program (THP)	\$17.2 M					
<b>ADDITIONAL FINANCING PROGRAMS</b>						
Modernization and Innovation (MI)	\$1.0 B					
Transportation Infrastructure Finance and Innovation Act (TIFIA)	Varies					

\* All right-of-way programs are considered EV eligible. All other programs are considered EV eligible. All other programs are considered EV eligible. All other programs are considered EV eligible.

For more information on the DOT funding and finance programs with EV eligibilities see page 16.

- [Federal funding](#) for alt fuels corridors
- [Low-No Program](#) grants
- Clean Cities Grants
- Utility partnerships
- State funded clean transportation programs
- National Drive Electric Week/Drive Electric Earth Day
- Private partners
- Future federal programs

## City Mayors with strong EV policies

Sylvester Turner, Mayor of Houston

Steve Adler, Mayor of Austin

Denny Durkan, Mayor of Seattle



## Statewide TE Plan - How do we grow EV adoption?

- EV charging: workplace, fleet and city parks
- Streamlined permitting for charging station installation
- Adopt EV ready building codes – Tucson, Seattle, Atlanta, Chicago examples
  - EV prewire new construction
- Electrify city fleets and equipment (street sweepers, garbage trucks)
- Dedicated staff EV specialist
- EV rebates
- Parking policies
- Electric bus fleets

# Working groups recommended TE support initiatives from various stakeholders

## Electric Utilities

- TE Collaborative meetings
- Education & outreach programs
- Dedicated electrification teams
- Incentive programs (EVs, chargers)
- EV rates
- Pilot charging programs
- Charging stations in underserved communities
- Fleet electrification

## State and/or Local Government

- Engage in TE Collaboratives
- Inclusive planning model
- Incentive programs (EVs, chargers)
- Group purchase programs
- EV Ready building codes
- ZEV legislation

## Representatives of Underserved Communities

- Engage in TE Collaborative meetings
- Promote inclusive planning model
- Partner w/ utilities and others on education & outreach, rideshare, training

## Transit Agencies and/or Fleet Operators

- Engage in TE Collaborative meetings
- Pilot electrification programs
- Purchase diverse models

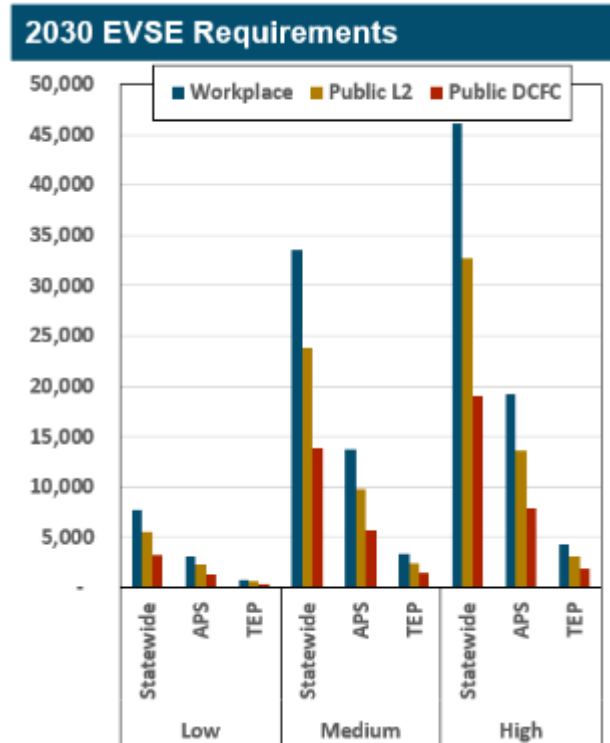
## Third-Party EV Service Providers (EVSPs)

- Engage in TE Collaboratives
- Collaborate w/ utilities on interconnection processes
- Develop additional public / workplace charging
- Prioritize coverage in underserved communities

# Where are EVs in 10 years?

Vehicle Segment	2030 EV Goal (Vehicles on the Road)		
	APS	TEP	State
Electric Light Duty Vehicles	450,000	95,000	1,076,000
Electric Medium Duty Parcel Delivery Trucks	1,450	545	3,830
Electric Transit Buses	290	110	785
Electric School Buses	525	200	1,425

	Low	Medium	High
Statewide eLDVs	249,771	1,076,000	1,479,422
Statewide EVSE by Type			
Residential	<249,771	<1,076,000	<1,479,422
Workplace	7,781	33,520	46,088
Public Level 2	5,526	23,805	32,731
Public DCFC	3,219	13,866	19,065



Source: [Statewide Transportation Electrification Plan March 2021](#)

**Let's talk EVs**



# Reference Material



# TE plan next steps

- There is deep interest across the stakeholder community to move TE forward in the state and to have concrete actions come out of this process
- This Phase II TE Plan is the first iteration of a statewide plan for Arizona and it will be revisited and refined in the future
  - APS and TEP envision revisiting the TE Plan every three years
- APS and TEP plan to continue collaborating with stakeholders
  - Future utility-led TE initiatives will incorporate stakeholder input to continuously improve upon TE programming in the state on an annual (TEP and APS jointly) and quarterly basis (TEP and APS separately)
    - To join APS' quarterly TE collaborative, please email [devon.rood@aps.com](mailto:devon.rood@aps.com)
    - To join TEP's quarterly TE collaborative, please email [JDonavant@tep.com](mailto:JDonavant@tep.com)
    - Email Devon or Julie if you are interested in the joint utility annual TE collaborative
  - First quarterly meetings to take place after ACC EV Workshop

# EV sales continue to increase even with COVID, totaling ~1.8M EVs

US Nationwide New EV Market Share March 2020 – Feb 2021

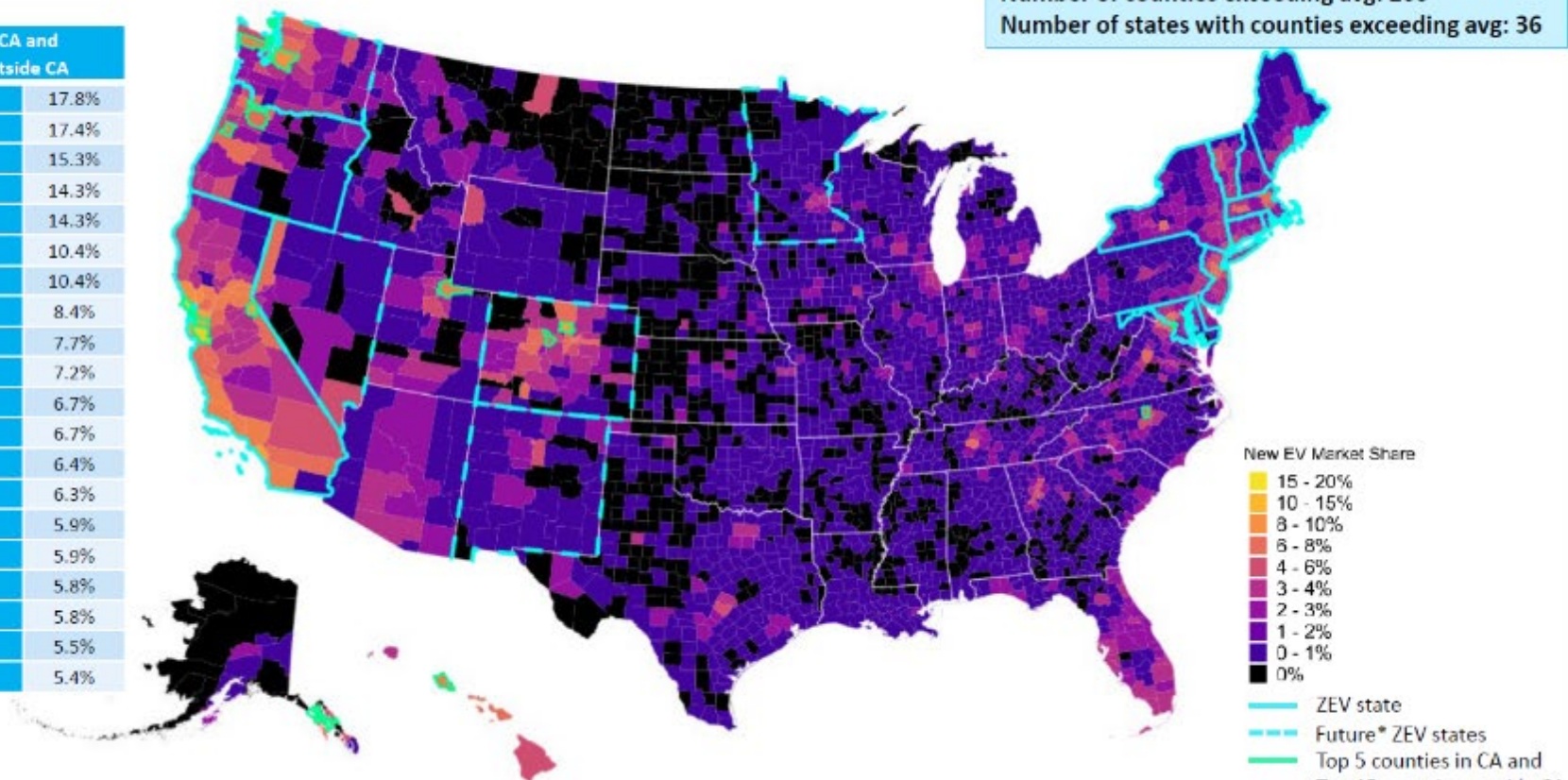
Nationwide avg new EV market share: 2.3%

Number of counties exceeding avg: 205

Number of states with counties exceeding avg: 36

## Top 5 counties in CA and Top 15 counties outside CA

Santa Clara, CA	17.8%
Marin, CA	17.4%
San Francisco, CA	15.3%
Alameda, CA	14.3%
Alpine, CA	14.3%
San Juan, WA	10.4%
Boulder, CO	10.4%
King, WA	8.4%
Hoonah-Angoon, AK	7.7%
Multnomah, OR	7.2%
Summit, UT	6.7%
Jefferson, WA	6.7%
Benton, OR	6.4%
Honolulu, HI	6.3%
Washington, DC	5.9%
Orange, NC	5.9%
Clackamas, OR	5.8%
Broomfield, CO	5.8%
Arlington, VA	5.5%
Summit, CO	5.4%



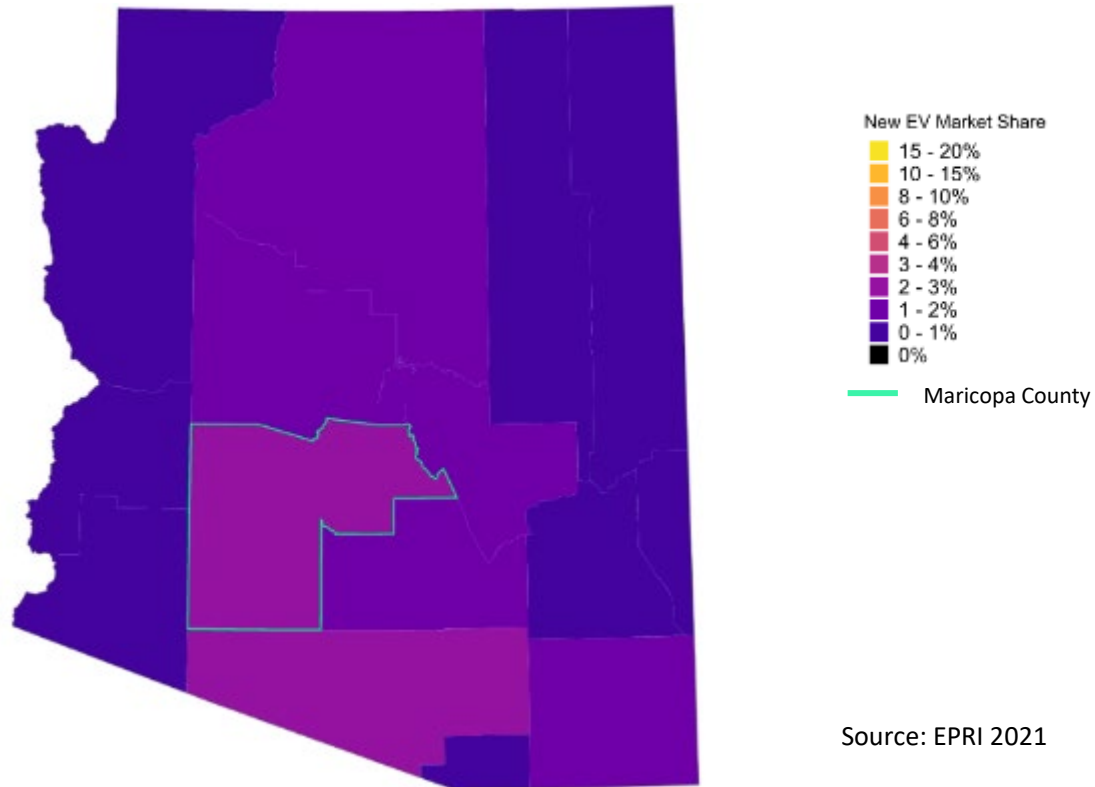
\*CO and WA will become ZEV states in 2023. MN, NM, and NV have announced that they intend to become ZEV states in the future.



# Arizona New EV Market Share March 2020 – February 2021

Top 5 Counties in AZ	
Maricopa	2.7%
Pima	2.5%
Coconino	1.7%
Yavapai	1.5%
Gila	1.2%

Arizona avg new EV market share: 2.4% (2.3% nationally)

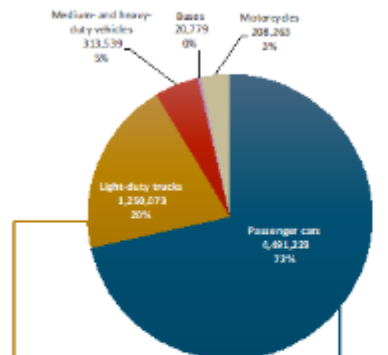


Source: EPRI 2021

# Arizona has 6.3 million registered on-road vehicles, mostly cars and light duty trucks

On-road gasoline or diesel vehicles registered in AZ\*

\*As of January 2020



Over 90% of registered vehicles are **passenger cars** and **light-duty trucks**

Source: Arizona Department of Transportation (ADOT)

## + ~4.5 million registered passenger cars, 1.3 million light-duty trucks

- ~70,000 of these are rentals
- Prior to COVID-19, over 75% of Arizona commuters were driving alone to work

## + Cities and universities also have large light-duty fleets

- E.g., ~2,500 sedans in the City of Phoenix fleet
- 330 LDVs / vans at Northern Arizona University; 680 at Arizona State University

## + Rideshare vehicle counts are not publicly available; not registered as such in Arizona

# Arizona has ~21K total buses on its roads, many of which are school buses

- + 20,779 buses registered with the Arizona Department of Transportation
  - 62% diesel, 38% gasoline
- + ~7,200 (35%) are yellow school buses
  - Prior to COVID-19, almost 300,000 students rode school buses every day, making it the most used mode of public transport in the state
- + Arizona's first electric school bus hit the road in January 2020 (Phoenix Union High School District)



Source: League of Conservation Voters

# Phoenix, Tucson, Flagstaff & Yuma operate ~1,200 transit buses

City	Agencies	Count of ≥35ft buses in fleet
Phoenix*	Valley Metro & City of Phoenix	939
Tucson	Sun Tran	253
Flagstaff	Mountain Line	29
Yuma	Yuma County Area Transit	24
<b>Total</b>		<b>1,245</b>

\*Including Glendale & Scottsdale shuttles & Regional Connectors)

- + Agencies also operate significant fleets of paratransit and other vehicles
- + Valley Metro is trialing a route with battery electric buses from 3 manufacturers to assess performance
- + Sun Tran launched first battery electric bus route in May 2020; received federal Low-No grant funding to take receipt of five in 2021 and an additional five in 2022
  - TEP provided charging infrastructure for initial bus & committed to in-kind funding for chargers and associated infrastructure as part of the Low-No grant.
- + Mountain Line has adopted an ambitious electrification plan to purchase battery electric buses on replacement of existing vehicles: full fleet by 2032

# Available EVs Guide on [aps.com/ev](https://aps.com/ev)

**Consumer Guide to Electric Vehicles**

Compare Available EVs | EV Benefits | Frequently Asked Questions

In the market for a new car? Here you can select and compare EVs that are available today. This guide highlights two types of EVs that plug into the electric grid to recharge their batteries. They are battery-electric—or what we sometimes call plug-in hybrids.

All electric vehicles run solely with an electric motor and battery power. They burn no gasoline or diesel fuel, so they emit no emissions and have no tailpipe at all. However, battery-electric vehicles are usually recharging, they come on-charging and their range between charges is increasing.

Plug-in hybrids plug an electric motor and battery with an internal combustion engine. Plug-in hybrids drive solely on electricity until the battery is mostly empty. Then the engine takes over and the car drives like a conventional hybrid. (Conventional hybrids, sometimes called “flex-fuel vehicles,” don’t plug in, so they’re not included here.)

**Compare Available EVs**

Explore all the new EV models that are available today.

Legend: BE = battery-electric; PHEV = plug-in hybrid electric vehicle; BEV = battery-electric vehicle; PHEV = plug-in hybrid vehicle

**Vehicle Search & Fuel Type & Electric Range & Gas + Electric Range & Starting MSRP**

1000 miles or more | All | All | All | All

**BEV COMPACT CARS**

**BEV COMPACT CARS**

Vehicle Search & Fuel Type & Electric Range & Gas + Electric Range & Starting MSRP				
2019 Chevrolet Bolt EV	BEV	259 miles	259 miles	\$37,499
2019 Chevrolet Bolt EUV	BEV	259 miles	259 miles	\$39,499
2019 Hyundai Ioniq Electric	BEV	170 miles	170 miles	\$34,445
2019 Hyundai Kona Electric	BEV	258 miles	258 miles	\$35,199
2019 Hyundai Ioniq Plug-in Hybrid	PHEV	29 miles	633 miles	\$25,405
2019 Kia Niro EV	BEV	239 miles	239 miles	\$36,899
2019 Kia Niro Plug-in Hybrid	PHEV	25 miles	600 miles	\$28,899
2019 Mercedes EQ	BEV	110 miles	110 miles	\$57,900
2019 Nissan Leaf	BEV	150 miles	150 miles	\$31,499
2019 Nissan Leaf Plus	BEV	226 miles	226 miles	\$38,700
2019 Toyota Prius Prime	PHEV	70 miles	540 miles	\$31,100
2019 Volkswagen Golf	BEV	110 miles	110 miles	\$31,999
2019 Volkswagen Golf GTI	BEV	110 miles	110 miles	\$31,999

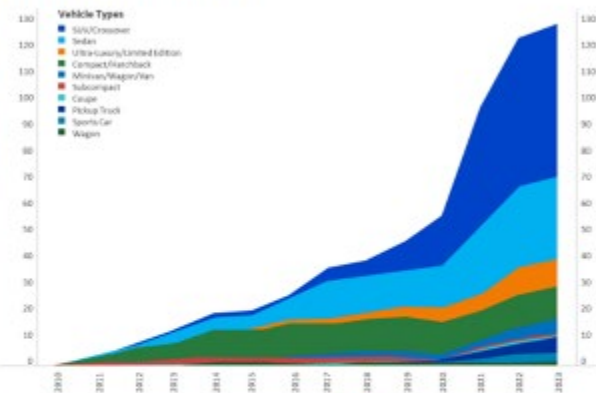
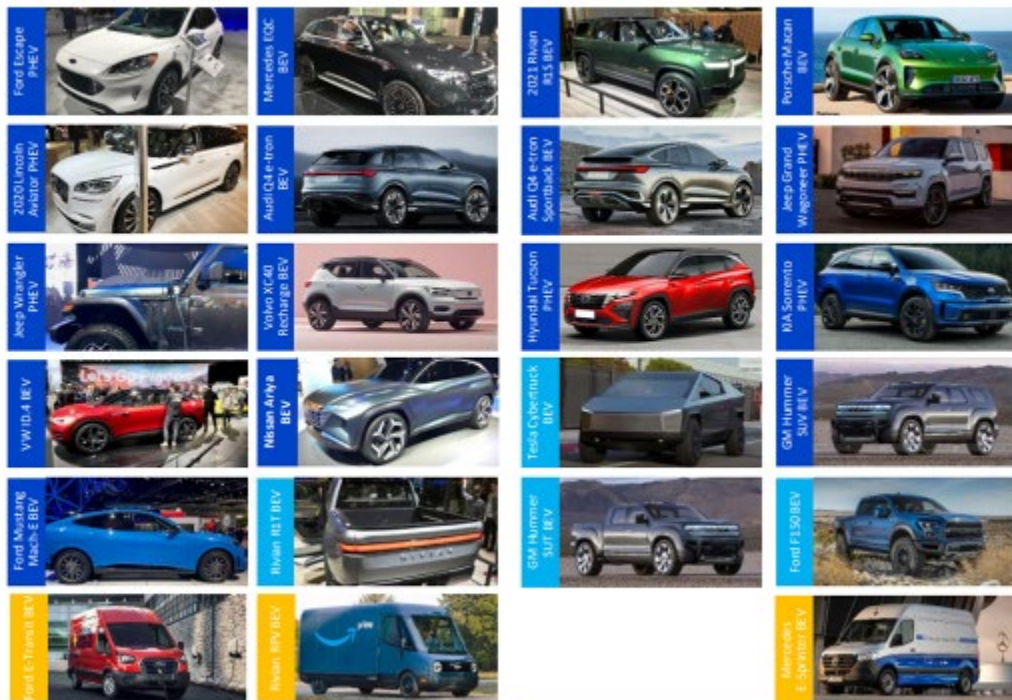
Learn more about EV charging  
[EPRI Guide to EV charging](#)

What is going on across  
the country in EV charging  
investments

[Investment in Public EV  
Charging in the United States](#)

# Electric trucks, crossovers, and SUVs arriving in 2021-2022

Key questions focus on announcements versus reality and local availability



2021

2022

Photo credit: Dan Bowermaster, EPRI, Mark Kosowski EPRI, bmwusa.com (media), ford.com (media), www.motortrend.com, www.caranddriver.com (accessed 9/13/2020)

www.epri.com

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# EV Charging Facts

- Vehicle Li-Ion EV battery capacity size:  
4.4kWh – 100kWh+
- ***On average an EV will travel  
3.5 miles per 1 kWh***
  - 4.4 kWh battery = 15.4 mile range
  - 100 kWh battery = 350 mile range



**AC EV charging  
acceptance rate:**  
1.5kW - 19.2kW  
(15 to 80-amp circuit)

**DC Fast charging  
acceptance rate:**  
20kW – 350kW

***DC Fast charging is  
480V 3-phase power  
and can provide  
recharge of up to  
80% range in 30  
minutes***



# Other states are already supporting TE through programs and initiatives

## Utah:

- EVSE Plan
- HD AFV tax credit
- EVSE rebate
- Incentives for residential TOU rates

## Colorado:

- Colorado EV 2020 Plan
- Programs for DCFC and fleets
- MD/HD zero-emissions by 2050 goal
- Joining ZEV

## Nevada:

- Utility EVSE incentives
- Utility EV Infrastructure Demo program
- Joining ZEV

## New Mexico:

- State Emissions Reduction Strategy
- EVSE funding
- Joining ZEV

## California:

- Large utility EVSE pilots
- EV rebates and tax credits
- Mandates for ZEVs across vehicle types, fleets in place or on the way



# Three Charging Levels, 4 Charging Connectors



## Level 1 - home

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- Less than 2 kW
- 2-5 miles of range per hour of charging

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- 208/240V, 1-Phase AC
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## DC Fast Charge – Public

208/480V, 3-Phase

- 24 to 1000 kW
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J1772 plug

Charging inlet



J1772 connector on **all EVs**. Charges level 1 and level 2, Tesla with adapter

Tesla



Chademo



CCS

