Electric Vehicles
Sustainable Cities Network SEE Workgroup
and EV Subgroup Meeting
8/10/21
Kathy Knoop
Energy Innovation Advisor, APS
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?

### Station Overview

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

Source: Alternative Fuels Database

Source: Plug share
Where are the public charging stations?

Source: Alternative Fuels Database
Where are the EVs Located?

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

Total EV population in Maricopa County 31,868
Total EVs in Arizona 42,000

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
More big EVs

- School buses
- Transit buses
- Delivery vehicles
- Garbage trucks
- Ferries
- Mining equipment
- Construction equipment
- Aviation
How are cities funding across the US?

- **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
<table>
<thead>
<tr>
<th>Electric Utilities</th>
<th>State and/or Local Government</th>
<th>Representatives of Underserved Communities</th>
<th>Transit Agencies and/or Fleet Operators</th>
<th>Third-Party EV Service Providers (EVSPs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE Collaborative meetings</td>
<td>Engage in TE Collaboratives</td>
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<td>Engage in TE Collaborative meetings</td>
<td>Engage in TE Collaboratives</td>
</tr>
<tr>
<td>Education &amp; outreach programs</td>
<td>Inclusive planning model</td>
<td>Inclusive planning model</td>
<td>Collaborate w/ utilities on interconnection processes</td>
<td></td>
</tr>
<tr>
<td>Dedicated electrification teams</td>
<td>Incentive programs (EVs, chargers)</td>
<td>Promote inclusive planning model</td>
<td>Pilot electrification programs</td>
<td>Develop additional public / workplace charging</td>
</tr>
<tr>
<td>Incentive programs (EVs, chargers)</td>
<td>Group purchase programs</td>
<td>Partner w/ utilities and others on education &amp; outreach, rideshare, training</td>
<td>Purchase diverse models</td>
<td>Prioritize coverage in underserved communities</td>
</tr>
<tr>
<td>EV rates</td>
<td>EV Ready building codes</td>
<td>ZEV legislation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot charging programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charging stations in underserved communities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fleet electrification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Working groups recommended TE support initiatives from various stakeholders
## Where are EVs in 10 years?

<table>
<thead>
<tr>
<th>Vehicle Segment</th>
<th>2030 EV Goal (Vehicles on the Road)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>APS</td>
</tr>
<tr>
<td>Electric Light Duty Vehicles</td>
<td>450,000</td>
</tr>
<tr>
<td>Electric Medium Duty Parcel Delivery Trucks</td>
<td>1,450</td>
</tr>
<tr>
<td>Electric Transit Buses</td>
<td>290</td>
</tr>
<tr>
<td>Electric School Buses</td>
<td>525</td>
</tr>
</tbody>
</table>

### 2030 EVSE Requirements

<table>
<thead>
<tr>
<th>Statewide eLDVs</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>249,771</td>
<td>1,076,000</td>
<td>1,479,422</td>
</tr>
</tbody>
</table>

### 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](https://example.com/statewide-trans-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
    • To join TEP’s quarterly TE collaborative, please email 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


Top 5 counties in CA and Top 15 counties outside CA

<table>
<thead>
<tr>
<th>County</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Clara, CA</td>
<td>17.8%</td>
</tr>
<tr>
<td>Marin, CA</td>
<td>17.4%</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>15.3%</td>
</tr>
<tr>
<td>Alameda, CA</td>
<td>14.3%</td>
</tr>
<tr>
<td>Alpine, CA</td>
<td>14.3%</td>
</tr>
<tr>
<td>San Juan, WA</td>
<td>10.4%</td>
</tr>
<tr>
<td>Boulder, CO</td>
<td>10.4%</td>
</tr>
<tr>
<td>King, WA</td>
<td>8.4%</td>
</tr>
<tr>
<td>Hoonah-Anagoon, AK</td>
<td>7.7%</td>
</tr>
<tr>
<td>Multnomah, OR</td>
<td>7.2%</td>
</tr>
<tr>
<td>Summit, UT</td>
<td>6.7%</td>
</tr>
<tr>
<td>Jefferson, WA</td>
<td>6.7%</td>
</tr>
<tr>
<td>Benton, OR</td>
<td>6.4%</td>
</tr>
<tr>
<td>Honolulu, Hi</td>
<td>6.3%</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>5.9%</td>
</tr>
<tr>
<td>Orange, NC</td>
<td>5.9%</td>
</tr>
<tr>
<td>Clackamas, OR</td>
<td>5.8%</td>
</tr>
<tr>
<td>Broomfield, CO</td>
<td>5.8%</td>
</tr>
<tr>
<td>Arlington, VA</td>
<td>5.5%</td>
</tr>
<tr>
<td>Summit, CO</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

Nationwide avg new EV market share: 2.3%
Number of counties exceeding avg: 205
Number of states with counties exceeding avg: 36

*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

<table>
<thead>
<tr>
<th>County</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maricopa</td>
<td>2.7%</td>
</tr>
<tr>
<td>Pima</td>
<td>2.5%</td>
</tr>
<tr>
<td>Coconino</td>
<td>1.7%</td>
</tr>
<tr>
<td>Yavapai</td>
<td>1.5%</td>
</tr>
<tr>
<td>Gila</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

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.

- ~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

Source: Arizona Department of Transportation (ADOT)
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)
Phoenix, Tucson, Flagstaff & Yuma operate ~1,200 transit buses

<table>
<thead>
<tr>
<th>City</th>
<th>Agencies</th>
<th>Count of ≥35ft buses in fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix*</td>
<td>Valley Metro &amp; City of Phoenix</td>
<td>939</td>
</tr>
<tr>
<td>Tucson</td>
<td>Sun Tran</td>
<td>253</td>
</tr>
<tr>
<td>Flagstaff</td>
<td>Mountain Line</td>
<td>29</td>
</tr>
<tr>
<td>Yuma</td>
<td>Yuma County Area Transit</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,245</strong></td>
</tr>
</tbody>
</table>

*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](http://aps.com/ev)

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.

Vehicle Types
- SUV/Crossover
- Sedan
- Other luxury/limited edition
- Compact/Hatchback
- Midsize
- Subcompact
- Compact
- Pickup Truck
- Sports Car
- Wagon

2021
2022

SUV

Pickup

Van

Photo credit: Dan Bowewi, EPR; Mark Kosowsky, EPR; bmwwusa.com (media); ford.com (media); www.motorweek.com; www.Laurantwick.com (accessed 9/13/2020)

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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

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

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

**Nevada:**
- Utility EVSE incentives
- Utility EV Infrastructure Demo program
- Joining ZEV

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

**New Mexico:**
- State Emissions Reduction Strategy
- EVSE funding
- Joining ZEV
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