TECH NEXT™

NASPO TECH NEXT SERIES

Electric Vehicles and Hybrid Vehicles

In this edition of the Tech Next series, we will explore:

What is an EV

EV capabilities

Total cost of ownership

What the central procurement office can do to help prepare your state for an increase in EV use.

DID you think 2020 would bring about George Jetson and his flying car? Flying cars may not be available yet, but Electric Vehicle technology is advancing by leaps and bounds.

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There are EV models available today to match the practical uses of most gasoline-powered vehicles. It is important to understand the driving needs of your fleet in order to determine the model of EV that provides the best value.

- How far does your average fleet vehicle drive in a day?
- How many passengers does your average fleet vehicle need to hold?
- Does your state currently have charging stations conveniently located for use?

If agency vehicles are only driven an average of 50 miles per day, then paying up for a model with a 300-mile capacity is likely unnecessary.

What is an Electric Vehicle?

Electric Vehicle or EV is an all-encompassing term used in this publication referring to two subsets of vehicles: all-electric vehicles (AEVs) and plug-in hybrid electric vehicles (PHEVs).

ALL ELECTRIC VEHICLES

- Powered solely by an electric engine.
- Fueled by a high capacity battery pack.
- Partially recharged through regenerative braking.
- Typical driving range of 150 to 250 miles depending on specifications.
- Most models fully charge in 9 to 11 hours using standard equipment.
- Most popular type of EV sold since 2014.
- Popular examples: Chevy Bolt and Tesla Model 3.

PLUG-IN HYBRID ELECTRIC VEHICLES

- Powered by an electric and a gasoline-powered engine.
- Electric motor is fueled by a battery pack.
- Partially recharged through regenerative braking.
- Range of up to 60 miles using only electric engine.
- Switches over between gasoline and electric engines to meet driving needs.
- Fully charges in 2 to 3 hours.
- Popular examples: Toyota Prius and Ford Fusion Energi.

CHARGE IT

Electric Vehicle Supply Equipment (EVSE) is available in three levels:

Level 1

VOLTAGE	RANGE	TIME TO CHARGE
120 volts	up to 80 miles	8-hour charge

The most compatible level of charging, level 1 is known to fit all EVs that are currently on the market, and charging is easily done at home or at the office.

Level 2

VOLTAGE	RANGE	TIME TO CHARGE
220 or 240-volts	up to 80 miles	4-hour charge

These outlets are also used by most electric clothes dryers, which are found in many houses today, and are easily installed in homes, public charging stations, or businesses.

Level 3

VOLTAGE	RANGE	TIME TO CHARGE
480+ volts	up to 90 miles	30-minute charge

Also known as DC fast charging, currently the fastest charging solution in the market.

ELECTRIC VEHICLES AND THE FEDERAL GOVERNMENT

The U.S. Department of Energy's office of Energy Efficiency & Renewable Energy began establishing Clean Cities Coalitions in 1993, and has since created over 100 local coalitions across the country. On July 21, 2016 the White House announced that nearly 50 industry members signed on to the ***Guiding Principles to Promote Electric Vehicles and Charging Infrastructure***. This signified a major commitment and collaborative effort on the part of numerous agencies including the federal government, states, communities, and the private sector. The goal is to create a national charging infrastructure to enhance electric vehicle use in the United States.

In 2018, Clean Cities Coalitions celebrated a cumulative impact on energy use equivalent to nearly 8 billion gallons of gasoline through the implementation of diverse transportation projects.

In 2019, multiple bills were introduced to either allocate additional funding for EV use or manufacturing. ***House Resolution 2337*** authorizes the upgrading of the United States Postal Service's vehicle fleet to low emission and fuel-efficient vehicles, with priority given to EVs. **The Vehicle Innovation Act of 2019** aims to support research and to develop innovative vehicle technologies related to EVs.

In May of 2019, Congress introduced the **Smart Cities and Communities Act**, which would allocate $1.1 billion in federal support over the next five years to local city technology initiatives. Recently proposed changes in automobile standards from the Trump administration have caused some **uncertainty about the future of the EV market**.

Capabilities

According to the **U.S. Department of Energy**, the electric vehicle market has experienced significant growth from fewer than 100,000 EVs on the road in 2012, to approximately 1.1 million by 2018, and an estimated 1.5 million on the road in 2020. Since 2014, a majority of new EV sales have been AEVs, though PHEV sales have also consistently grown. This demand for EVs is expected to continue growing, with projections of up to **19 million EVs in use in the U.S. by 2030**.

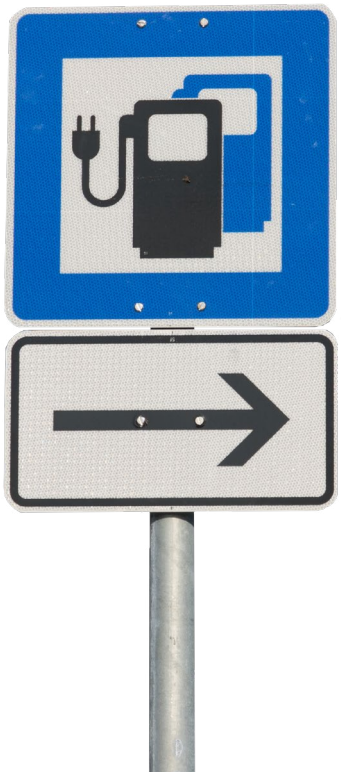
The average AEV currently on the road can travel 100 miles without needing to recharge, while the average PHEV currently on the road may go anywhere from 10 to 50 miles before the gasoline engine takes over. The batteries that power these vehicles are typically made from lithium-ion and are essentially just larger versions of the batteries in cell phones and other wireless devices. **Data** suggests the life of an AEV battery could last the lifetime of the vehicle [approximately 10 years] before needing to be replaced, and in some models, it has been suggested that the battery may outlive the usable life of the vehicle. One factor that can affect battery performance and driving range is temperature. EV batteries take longer to charge in cold weather conditions. Also, use of climate control systems like air conditioning during hot weather can syphon off battery power and decrease driving range.

The EPA's comparison standard for EVs says 33.7 kilowatt-hours of electricity is the fuel equivalent of 1 gallon of gas.

Today's AEVs have an average fuel economy of 104 MPGe (miles per gallon equivalent).

Innovation

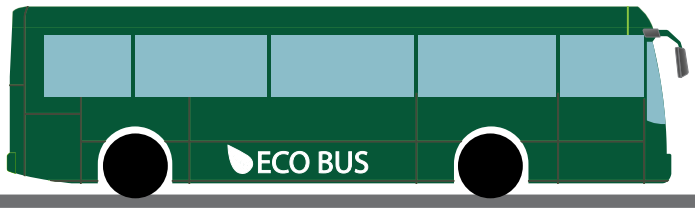
While PHEV technology has remained consistent, AEV capabilities have quickly evolved. PHEVs have consistently averaged between 25 and 35 miles of all-electric range while the average range of new AEVs has grown from approximately 70 miles to over 200 miles. In recent years, new battery and charging technologies have produced great leaps in power, range, and charging times.



Common Fleet Vehicle Capabilities

While the mention of EVs may invoke thoughts of the compact or ultra-compact class, **the most common EVs sold are midsize cars**. Sales for sport utility vehicle (SUV) AEVs and PHEVs are growing. Standard four-wheel drive SUVs, such as the Tesla Model X and Kia Niro, were the third best-selling size class in 2018, per **this report**. The table below represents common fleet vehicle types and their charging time, range, and their capabilities:

VEHICLE TYPE	VEHICLE SIZE	2020 MODEL	ELECTRIC MOTOR RANGE	CHARGING TIMES
AEV	Mid-Size Car	Chevy Bolt	259 miles	Level 2: 10 hours
	Mid-Size Car	Nissan Leaf S	226 miles	Level 2: 11 hours for full charge or 8 hours for 150 miles
	All-wheel-drive SUV	Kia Niro	239 miles	Level 2: 9.5 hours Level 3: 75 minutes for 80% capacity or 30 minutes for 100 miles
PHEV	Mid-Size Car	Toyota Prius	25 miles	Level 2: 2 hours
	Mid-Size Car	Ford Fusion Energi	26 miles	Level 2: 2 hours
	Minivan	Chrysler Pacifica	32 miles	Level 2: 2 hours



Public Transit

One of the fastest growing sectors of EV use is in public transit. There are at least 10 companies currently manufacturing buses in the U.S. market, including all major school bus makers. There are nearly 600 electric buses currently in use for public transportation in cities across the country, and more than 400 electric school buses. **According to the United States Federation of Public Interest Research Groups**, 13% of all transit authorities in the U.S. have purchased e-buses, and current goals anticipate at least 33% of all buses in use in the U.S. to be electric by 2045.

Most electric buses are made-to-order so the capabilities can vary widely depending on specifications and conditions of use. A **study** of electric bus pilot programs found that from 2014 to 2018, electric buses used for public transit systems averaged a fuel efficiency of 16.5 MPGe compared to the standard diesel bus efficiency of 3.8 MPG. USPIRG conducted **case studies** of some of the early adopters of e-buses and charging infrastructure. Using fast-chargers, Clemson, South Carolina has reported full charging times as low as 6 minutes, while getting more than 40 miles in range. Chicago's public transit e-buses can fully charge in under 10 minutes, with ranges from 75 to 150 miles.

EV Charging and the Power Grid

The growth of EV use isn't just a challenge for automakers. Power providers and utility companies will have to plan for the growing demand from electric vehicles, which could require an increase in peak capacity. In 2018, the average PHEV consumed 2,500 kilowatt-hours (kWh) of electricity, and the average AEV consumed 3,700 kWh of electricity. When maintaining a fleet, **charge management** is crucial. Managers should implement policies to ensure EV charging does not occur during the utility provider's peak demand times to avoid an increased demand charge. Peak demand is typically between 6 p.m. and 8 p.m., as people return home from work. There are already software products on the market to manage and even automate EV charging to avoid straining utility systems or inflating invoices.

A 2019 **Department of Energy report** concluded that the U.S. electrical network has the available generation capacity and the ability to expand generation capacities to accommodate even the highest projected growth of EV use over the next decade. It also determined that the growth of the EV industry and EV use could stimulate growth in the power-generation industry. According to the **Alternative Fuel Data Center** there are over 25,000 public EV charging stations with more than 78,000 connectors across the U.S. New methods for charging are starting to emerge, including ultra-fast chargers, wireless chargers, and battery swapping, while more than half of states now have EVSE incentives in place. You can check the link above to see where public EV charging stations are near you.

Total Cost of Ownership Comparison

Electric vehicles, much like their gasoline counterparts, have an approximate lifespan of 10 years. During the vehicle lifecycle, these factors contribute to total cost of ownership:

- Fuel/Power source
- Maintenance
- Upfront cost/Resale Value
- Infrastructure

This report from market research firm Procurement IQ (Note: this report is accessible to NASPO members via their ProcurementIQ member benefit. If you are not a NASPO member, you will be required to purchase access to it), notes the following on price forecast for passenger vehicles:

> "Buyers that purchase electric vehicles will be able to forego fuel costs but will still spend money on powering their vehicles.
>
> Buyers will need to determine the cost of electricity per kilowatt-hour (kWh) to fully assess total costs.
>
> While these costs vary from state to state, buyers can expect to pay significantly less on electricity than they would on fuel."

The report goes onto state that over the next 2 years (2020-2022), gasoline powered vehicles up-front costs will have an average annual rise of 1%.

Electric vehicle trends for 2020 include a lowered up-front price tag for AEVs/PHEVs. As the price of lithium batteries continues to drop steadily, AEVs and PHEVs will present price parity to the market with their gasoline powered counterparts. Deloitte's research shows price parity of the AEV/gasoline market by 2022.

In 2018, New York city released total maintenance cost information on its fleet vehicles. The chart shows a comparison of cost-savings on the maintenance of their AEVs, PHEVs and traditional gasoline vehicles. This chart reflects AEV maintenance costs were 25% of their gasoline equals.

From NYC's fleet, AEVs had the lowest record maintenance cost for 2018, even when compared to the similar PHEVs. It should be noted, AEVs do not require oil or spark plug changes, as well as air filter replacements. Mufflers and catalytic convertors cannot be stolen from the fleet vehicles and transmissions won't need to be serviced because AEVs do not have these parts. Regenerative braking produces less wear and tear on brake pads, extending use.

NYC FLEET

Saving Maintenance Costs with Electric Vehicles

VEHICLE MODEL	SYSTEM	NUMBER	2018 MAINTENANCE COST
Bolt	All electric BEV	93	$204.86
Focus	Gas	11	$1,805.24
Focus Electric	All electric BEV	7	$386.31
Fusion	Gas	62	$1,621.34
Fusion Energi	Hybrid Gas/Electric Plug in	154	$496.73
Fusion hybrid	Hybrid Gas/Electric	205	$1,310.89
Leaf	All electric BEV	149	$344.14
Prius	Hybrid Gas/Electric	1,131	$893.31
Taurus	Gas	38	$922.67
Volt	Hybrid Gas/Electric Plug in	43	$1,210.40

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Forbes predicts that as the EV tax credit phases out over the next two years, the resale value of EVs will increase.

The central procurement office should engage with their fleet manager to discuss charging abilities, and utility constraints. Incorporating EVs as a part of government fleets can be an expensive and time-consuming process due to the need to provide an infrastructure that supports EV charging and use. Creating the initial network of charging stations is a multi-layered issue with multiple stakeholders.

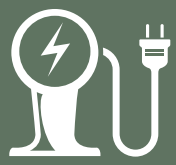
Some potential unique challenges and stakeholders to consider:

- Wiring issues
- Public Works
- Planning and Zoning
- Standardized process

Some cities have been taking steps to address their charging infrastructure. Here is a study from the Department of Energy conducted over the city of Columbus, Ohio, over their EVSE infrastructure. Essentially, the study found that to ease range-phobia of short-range AEV drivers, extra charging stations needed to be built. For the central procurement office, this means potentially accruing additional costs.

EVs and the Central Procurement Office

State and local governments should anticipate AEV/PHEV growth in their communities. As EV use grows, the need to provide and encourage development of an accessible network of charging stations throughout the community must be addressed. The state will be tasked with providing a charging infrastructure. Infrastructure improvements can be time consuming, costly, and complex in nature but, with proper planning and implementation, infrastructure change is can be done.



AEVs/PHEVs charging stations come with a different set questions needing to be answered.

- **Is Public Works going to charge for use of electricity?**
- **Will charging stations be regulated so that the public may use them?**
- **If not, how will you address limiting access from private citizens?**

Most states cannot charge fees directly because the state is not a utility provider. So, how will you charge for use? Space rental? Meters? If the charging stations are not open to private citizen use, the state will incur additional electricity costs. If your state is not already laying groundwork for an increase in EV usage, these beginning costs can be expensive and extensive. Depending on your state's specific needs and fiscal responsibilities, purchasing EVs for fleet use and installing initial infrastructure for charging stations may not always be best value.

Public-Private Partnerships

When it comes to creating EVSE infrastructure, the central procurement office (CPO) does have a tool in their toolbox—public-private partnerships (P3s). P3s are a collaborative effort between the government and private business for a public purpose. P3s have been in the news both for their successes, like the **West Coast Electric Highway**; and for their failures, like **this review from the European Union** over 9 different major p3 initiatives. Harvard Business Review has identified some common traits in successful P3 ventures which include:

- Focusing on the productive partnership, more so than iron-clad contracts
- Built-in mechanism to share perspectives and updates on the project continuously
- Effective ways to recover from failures to deliver

EVSE Request for Proposal

Crafting the request for proposal (RFP) for EVSE can be intimidating. Like all RFPs, using correct scope of work and specifications allows for maximum competition and the acquisition of best value. The Federal Department of Energy released a **RFP guide to EVSEs**. The guide provides a list of the 27 common specifications for EVSE, guidance on framing the scope of work, and additional attachments on EVSE pricing and installation costs. The guide references the importance of keeping in mind distance from an electricity source for EVSE. This greatly affects price and can come at a cost to the taxpayer if extensive installation is needed. When planning where the EVSE will be installed, it is considered best practice to consult with an electrical contractor or engineering firm.

EVSE Network

One of the major features presented in the guide, is the importance of network connection in EVSE. **The Internet of Things**, previously discussed in the Tech Next Series, is changing the way people interact with the world around them. EVSE is no different. Governments may wish to monitor data usage, use online updates for systems or require payment. Proper connection of the EVSE into the network can save governments and citizens time, money, and provide easily accessible data for analysis. EVSE can be a major expenditure, but the network connection can deliver a return on the original investment. It can provide in-depth metrics to support the cost savings of lowered manual maintenance, and possibly a new revenue source if the city/state requires payment for public use.

EV FLEET BENEFITS AND CHALLENGES

BENEFITS	CHALLENGES
Environmental impact: zero carbon emissions and lowered carbon footprint	Retail price of EVs has not reached market price parity with their gasoline counterparts
Average fuel economy of 104 MPGe (miles per gallon equivalent)	Initial up-front cost of infrastructure (EVSE)
Less maintenance than traditional gasoline powered vehicles	Regulation of public use of EVSE: • Availability • Cost • Monitoring
Financial incentives including tax breaks, subsidies and grants	Charge management of fleet and increased utility costs
Decrease in over-all spend of petroleum-based fuels	New training for fleet maintenance workers
Lower total cost of ownership	Disposal of depleted batteries
Level 1 charging available universally	Range constraints

Interested in purchasing an EV?

Check out **this link** for more information about what opportunities your state may have available.

STATE INITIATIVES FOR ELECTRIC VEHICLES

- In 2020, the state of **Maine put forth legislation**, that if successful, would move the state's public schools to all electric school buses by 2040.

- In 2017, more than 30 cities and counties across the country committed to purchase over 1,300 vehicles before the end of 2020, forming the **Climate Mayors Electric Vehicle Purchasing Collaborative**.

- Former California Governor Jerry Brown signed an **executive order** in 2018, setting a goal of five million electric vehicles on the states' roads by 2030.

- One of the nation's most visited cities Orlando, Florida partnered with nonprofit Electrification Coalition, which aims to accelerate EV adoption across the country to create **Drive Electric Orlando**, a vehicle renting program focused on providing electric vehicles to travelers.

- Boston, Massachusetts' **EV policy** in 2019 mandates 25% of citywide parking must be equipped with EV chargers.

- Recent pledges by California, New York City and Seattle to transition to zero-emission fleets mean that 33% of all transit buses in the U.S. are now committed to go electric by 2045.

- Atlanta, Georgia passed a **city ordinance in 2017** requiring all new residential homes and public parking facilities to accomodate EVs.

- In 2019, Washington **began a study** to determine the feasibility and resource requirements for all public fleets in the state to achieve substantial conversion to EVs by 2025, 2030, and 2035, and analysis of the financing mechanisms available to fund the transition.

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