Best Practices – EV Charging in Parking Facilities

Carolina Parking and Mobility Association (CPMA) Webinar

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Agenda

- Terminology
- History of Electric Vehicles
- Infrastructure (Charging Stations)
- Barriers Preventing Higher Adoption
- Types of Electric Vehicle Charging Stations
- Best Practices
  - Design Considerations
  - Operational Considerations
  - Charging Station Recommendations
- The Future
- Questions

Terminology

- **ICE**: Internal Combustion Engine
- **PEV**: Plug in Electric Vehicle
  - BEV: Battery Electric Vehicle
  - PHEV: Hybrid Electric Vehicle - ICE with Electric Motor backup
  - EREV: Extended Range Electric Vehicle - Electric Motor with ICE backup
- **FCEV** : Fuel Cell electric vehicle
- **HEV:** Hybrid Electric Vehicle. Non plug in
- **EVCS**: Electric Vehicle Charging Station
- **EVSE**: Electric Vehicle Supply Equipment
- **ALMS** : Automatic Load Management System

Source: currentev.com/blog/bev-erev-phev-hev-what-do-they-mean-an-ev-dictionary/

Image courtesy Jaguarusa.com

Source: NPA PCC EV Charging White Paper

History

1832

Photo courtesy of Wikimedia Commons.

1832

First Crude Electric Vehicle Is Developed

Around 1832, Robert Anderson develops the first crude electric vehicle, but it isn't until the 1870s or later that electric cars become practical. Pictured here is an electric vehicle built by an English inventor in 1884.

1912

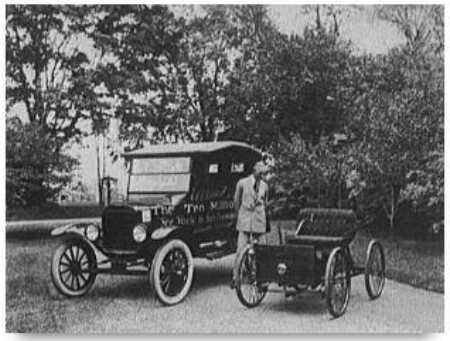


Photo courtesy of the Library of Congress.

1908 – 1912

Model T Deals a Blow to Electric Vehicles

The mass-produced Model T makes gas-powered cars widely available and affordable. In 1912, the electric starter is introduced, helping to increase gas-powered vehicle sales even more. Pictured here is Henry Ford with the first Model T and the 1 millionth.

The peak (1900 to 1912)

Photo courtesy of the Library of Congress.

1900 – 1912

Electric Cars Reach Their Heyday

By the turn of the century, electric vehicles are all the rage in the U.S., accounting for around a third of all vehicles on the road. Pictured here is Fifth Avenue in New York City around this time, showing the range in vehicle options available.

The decline (1920 to 1935)

Photo courtesy of the National Museum of American History.

1920 – 1935

Decline in Electric Vehicles

Better roads and discovery of cheap Texas crude oil help contribute to the decline in electric vehicles. By 1935, they have all but disappeared. Pictured here is one of the gasoline filling stations that popped up across the U.S., making gas readily available for rural Americans and leading to the rise in popularity of gas-powered vehicles.

Source: Department of Energy

History

1968

Photo courtesy of EPA, U.S. National Archives.

1968 – 1973

Gas Prices Soar

Over the next 30 years or so, cheap, abundant gasoline and continued improvement in the internal combustion engine created little need for alternative fuel vehicles. But in the 1960s and 1970s, gas prices soar through the roof, creating interest in electric vehicles again.

1973

Photo courtesy of Frank Lodge, U.S. National Archives.

1973

The Next Generation of Electric Vehicles

Many big and small automakers begin exploring options for alternative fuel vehicles. For example, General Motors develops a prototype for an urban electric car, which the company displayed at the First Symposium on Low Pollution Power Systems Development in 1973.

1979

Photo courtesy of Dick Swanson, U.S. National Archives.

1979

Interest in Electric Cars Fades

Compared to gas-powered cars, electric vehicles at this time have drawbacks, including limited performance and range, causing interest in electric cars to fade again.

1997

Photo courtesy of NREL.

1997

First Mass-Produced Hybrid

Toyota introduces the first mass-produced hybrid, the Prius. In 2000, Toyota releases the Prius worldwide, and it becomes an instant success with celebrities, increasing its (and the electric vehicle's) profile.

Source: Department of Energy

History

2010

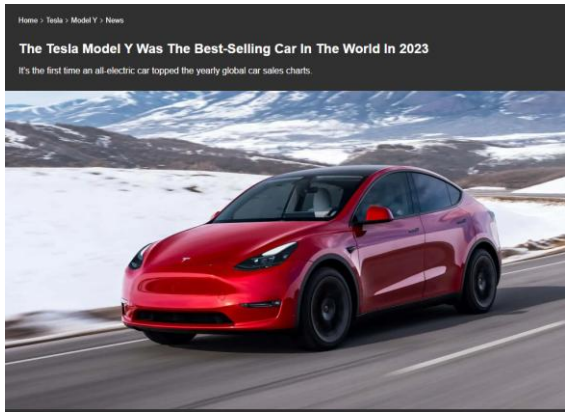
Photo courtesy of Nissan North America.

2010

Nissan Launches the LEAF

In December 2010, Nissan releases the LEAF, an all-electric, zero tailpipe emissions car. In January 2013, Nissan begins assembling the LEAF in Tennessee for the North American market thanks to a loan from the Energy Department.

2023



Tesla Model Y Best Selling Car Globally in 2023
1.2M Units Sold

Source: Department of Energy

History

- 2014 – 23 Plug in EV’s Models available
- 2023 – Over 40 Plug in EV Models available
- 2023 – 9.5 Million EV’s sold globally (Reuters) & 1.2 Million sold in the U.S. (Cox Automotive)
- 2040 – 66 Million EV’s will be sold (2/3 of global car sales – Bloomberg)

Source: Department of Energy

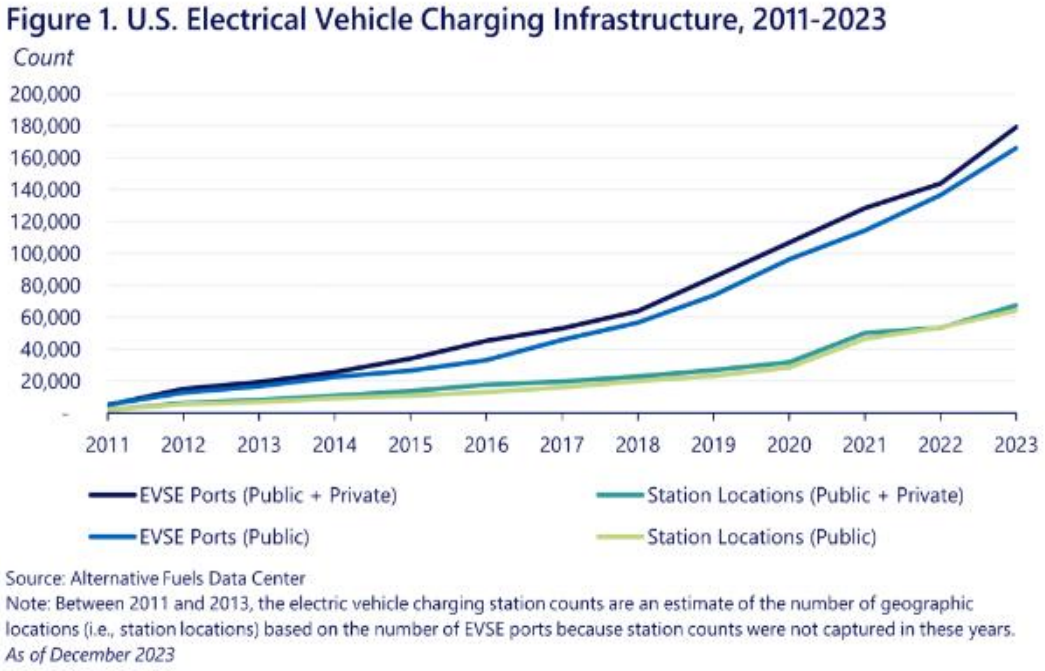
Barriers Preventing Higher Adoption

- Range Anxiety
- Infrastructure (Charging Stations) Availability
- Infrastructure (Charging Stations) Reliability
- Initial Vehicle Purchase Cost
- Perception of EV’s in General

Infrastructure (Charging Stations)

- 2023
  - 2.3 Million EV's in USA
  - 165,000 Public Charging Ports
  - Compared to 900,000 to 1.8M gas pumps
- 2030
  - 500,000 EV stations available (CNBC)
  - Per The White House.gov website:

    1.2 Million EVCS are needed



Types of Electric Vehicle Charging Stations

Level	Power Output	Typical Use	Typical Circuit Type	Typical Charging Rate	Typical Time for Full Charge*
AC Level 1	1.0 kW	Home	120 V / 15A	2 to 5 miles per hour of Charge	40 to 50 hours
AC Level 2	7.0 kW to 19.0 kW	Home/Work/Public	208 to 240 V / 40A	20 to 40 miles per hour of Charge	4 to 10 hours
DC Fast (Level 3)	50 to 350 kW (Most are 150/250/350)	Public	400 to 1000 V / 100A	180 to 240 miles per hour of charge	20 mins to 1 hour

Source: US Department of Transportation
*Assumes 70 kWh Battery Size

Types of Electric Vehicle Charging Stations

Level 1 EVCS - $160

Level 2 EVCS (Residential) - $600

Level 2 EVCS (Commercial)
$5,000 to $15,000 (dual head)

Level 3 DC Fast (Public)
$50,000 to $100,000

Best Practices - Design Considerations

New Construction: Code Requirements

- Most States adopt National Code, but can issue Amendments for stricter requirements (CAL Green)
- Local/City Authorities may also issue Amendments to the Building Code for stricter requirements
- Code Requirements typically set EV Charging Spaces by percentage of total parking spaces in facility
- Codes are typically stated as EV Capable, Ready, or Installed (defined next slide)
- Parksmart Recommendations

TABLE 1: SAMPLE EV-INTEGRATED CODE PROVISIONS[8]

Municipality/State	Year	Process Type	Single-Family	Multifamily	Commercial
Orlando, FL	2021	Land Development Code	-	20% EV-Capable	10% EV-Capable, 2% EV-Installed (250+ spaces)
Avon, CO	2021	IECC / IRC	1 EV-Ready Space per dwelling Unit	5% EV-Installed, 10% EV-Ready, 15% EV-Capable (7+ spaces)	5% EV-Installed, 10% EV-Ready, 15% EV-Capable (10+ spaces)
St. Louis, MO	2021	IBC / IRC	1 EV-Ready Space per dwelling Unit	2% EV-Installed, 5% EV-Ready (increases to 10% in 2025)	2% EV-Installed, 5% EV-Ready
Madison, WI	2021	Zoning Code	-	2% EV-Installed, 10% EV-Ready (increases by 10% every 5 years)	1% EV-Installed (increases by 1% every 5 years), 10% EV-Ready (increases by 10% every 5 years)
Washington D.C.	2021	Green Building Ordinance	-	20% EV-Ready (3+ spaces)	20% EV-Ready (3+ spaces)
Summit County, CO	2020	Green Code	1 EV-Ready Space per dwelling Unit	5% EV-Installed, 10% EV-Ready, 40% EV-Capable (10+ spaces)	5% EV-Installed, 10% EV-Ready, 40% EV-Capable (25+ spaces)

DC Fast Charging

[5 Points] 2 or more DC fast charging ports are installed.

[4 Points] 1 DC fast charger installed.

Level II Charging

[5 Points] 2 or more AC Level II EV charging ports, equaling at least 1% of total available parking spaces.

[4 Points] 2 or more AC Level II EV charging ports, equaling at least 0.5% and not more than 1% of total available parking spaces.

[2 Points] At least 1 AC Level II EV charger equaling less than 0.5% of the total available parking spaces.

Level I Charging

[1 Point] Level I equipped reserved parking spaces equaling at least 0.5% of total available parking.

Source: IPMI Planning, Design & Construction Committee
Parksmart Certification Standard

Best Practices - Design Considerations

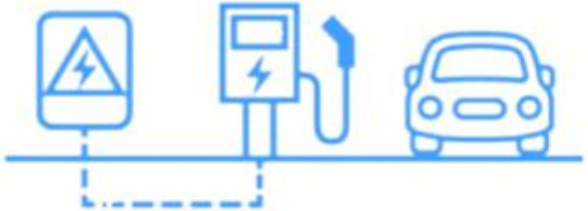
New Construction: EV Readiness

EV Capable

Installed EV panel with electrical capacity, dedicated circuits, and conduit paths (no wire) to location of EV Chargers

EV Ready

Installed EV panel with electrical capacity, dedicated circuits, and conduit paths (with wire) to location of EV Chargers and terminated in a J Box



EV Installed

Parking space with an EV Charger installed and ready for use

Source: IPMI Planning, Design & Construction Committee

Best Practices - Design Considerations

Where to locate EV Charging Spaces – New Construction

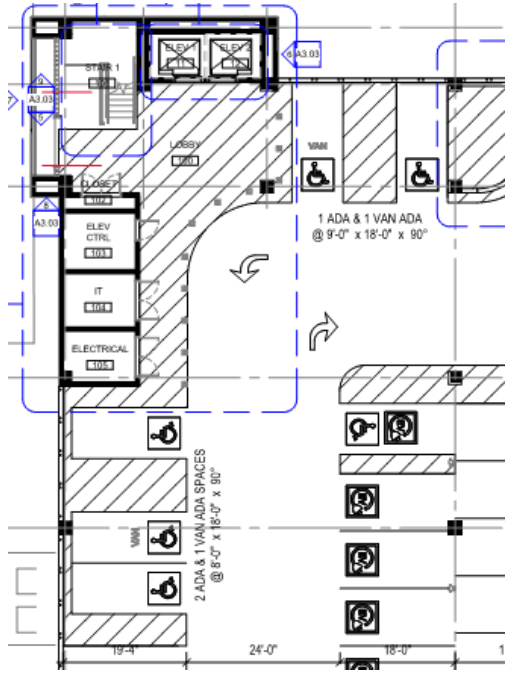
- Per State/Local Authority Requirements
- By Elevator Cores / Pedestrian Access
  - Secondary priority to ADA Parking
- Proximity to Electrical Room
- Vertical Stacking vs. Horizontal

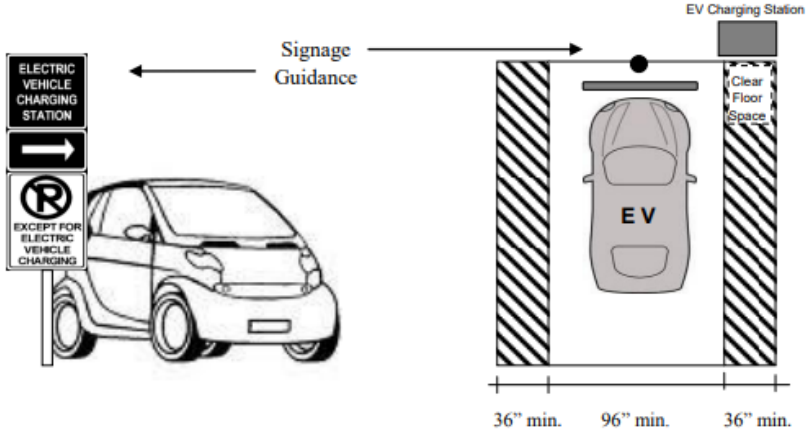
Where to locate EV Charging Spaces – Existing Facility

- Existing Infrastructure dependent
- Similar too New Construction

Layout of EV Charging Spaces

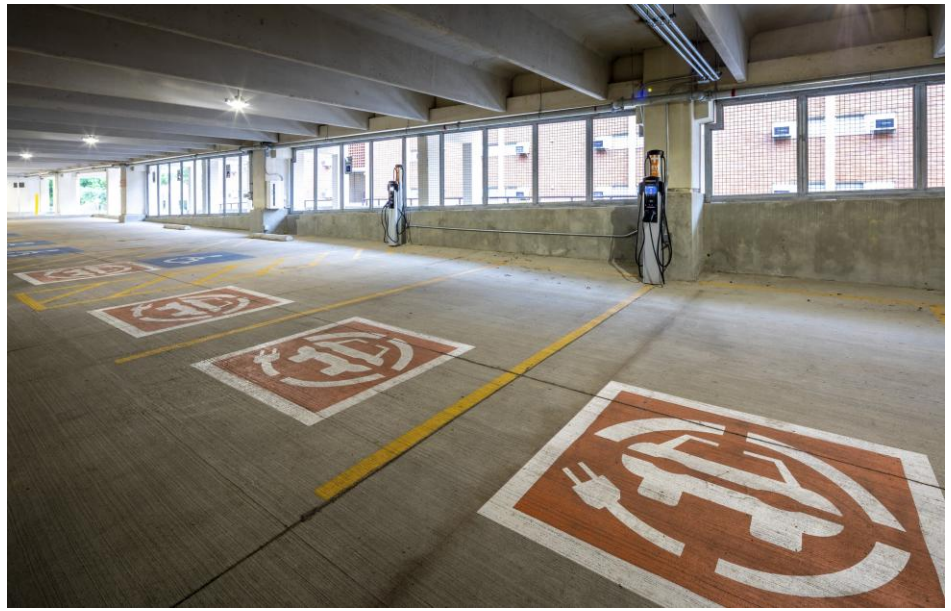
- Similar too ADA Parking Spaces with Access Aisles on both sides of space
- Located EV Charger at front of Access Aisle
- Provide Accessible (ADA) Charging Space(s)





Best Practices - Charging Station Recommendations

- Parking Garages & Surface Lots
  - 1% to 2% Day One
  - Up to 5% EV Capable/Ready
- State of California - Cal Green Requirements



Multifamily Dwellings

Required Percent of Total Parking Spaces to be "EV Capable"	Optional Tier 1 Percent of Total Parking Spaces to be "EV Capable"	Optional Tier 2 Percent of Total Parking Spaces to be "EV Capable"
10%	15%	20%

- If guest parking is available, at least one "EV Capable" space must be for guest parking.

Hotels & Motels

"EV Capable" spaces are required based on the total number of parking spaces at all types of parking facilities (e.g., garages, flat lots, valet).

Nonresidential

Total Number of Parking Spaces	Required Number of Parking Spaces to be "EV Capable"	Optional Tier 1 Number of Parking Spaces to be "EV Capable"	Optional Tier 2 Number of Parking Spaces to be "EV Capable"
0-9	0	1	1
10-25	1	2	2
26-50	2	3	4
51-75	4	5	6
76-100	5	7	9
101-150	7	10	12
151-200	10	14	17
201	6% of total	8% of total	10% of total

Best Practices – Operational Recommendations

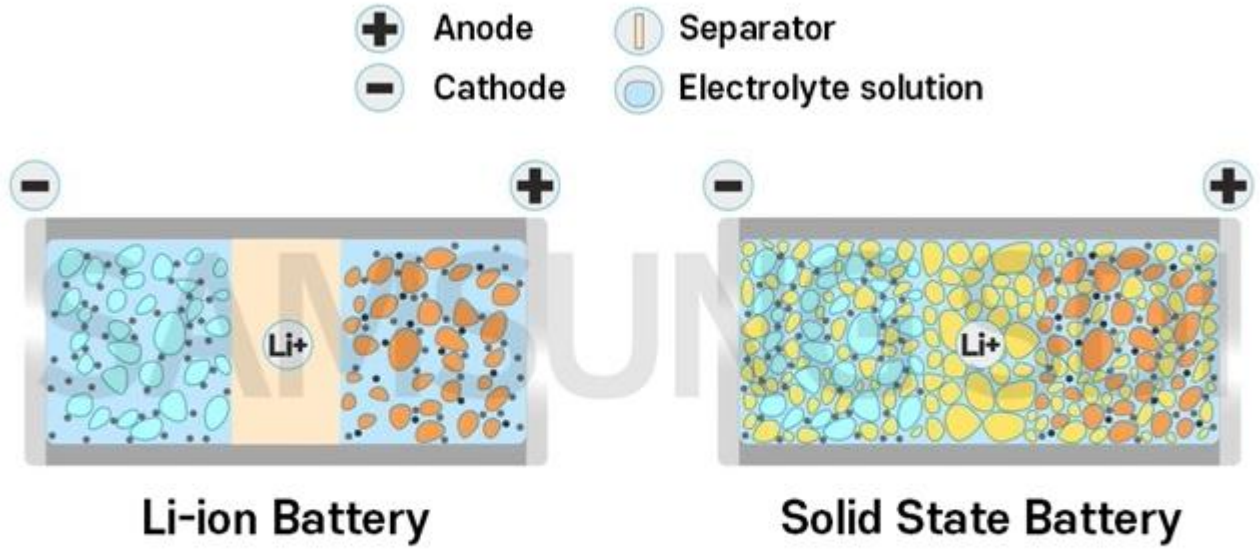
- Managing EV Charging Spaces
  - Time Restrictions
  - Fee Restrictions
  - Valet Parking

The Future

- Wireless Charging (possible retrofit of vehicle)
- Solid State Batteries

How Wireless EV Charging Works

https://pluglesspower.com/install/



Per Automotiveworld.com:

- Solid State batteries can carry 30% to 50% more energy density (stored energy) than Lithium-ion batteries
- 90 kWh Lithium-ion battery currently weighs around 800lbs and same SS battery will weigh around 500 – 600lbs
- SS batteries are safer during fast charging with less concern with thermal runaway (rapid temperature increase)
- SS batteries reduce amount of graphite and cobalt

Questions?

Thank You !!