# EV Mobility

## The Future is Now

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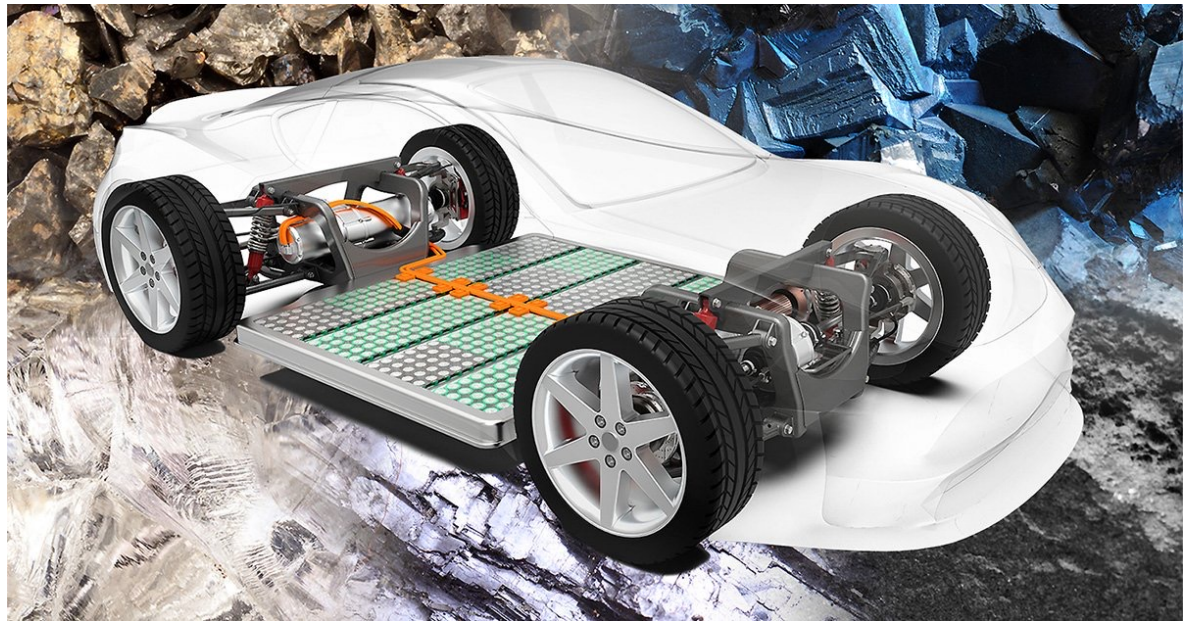
# The New “Electric Slide”:  from ICE to EV



# Cathy Fisher

President,

Quistem, LLC

EV Enthusiast

Special thanks to **Caroline King** (student) for EV research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# Current EV Landscape

# Key Driving Factors

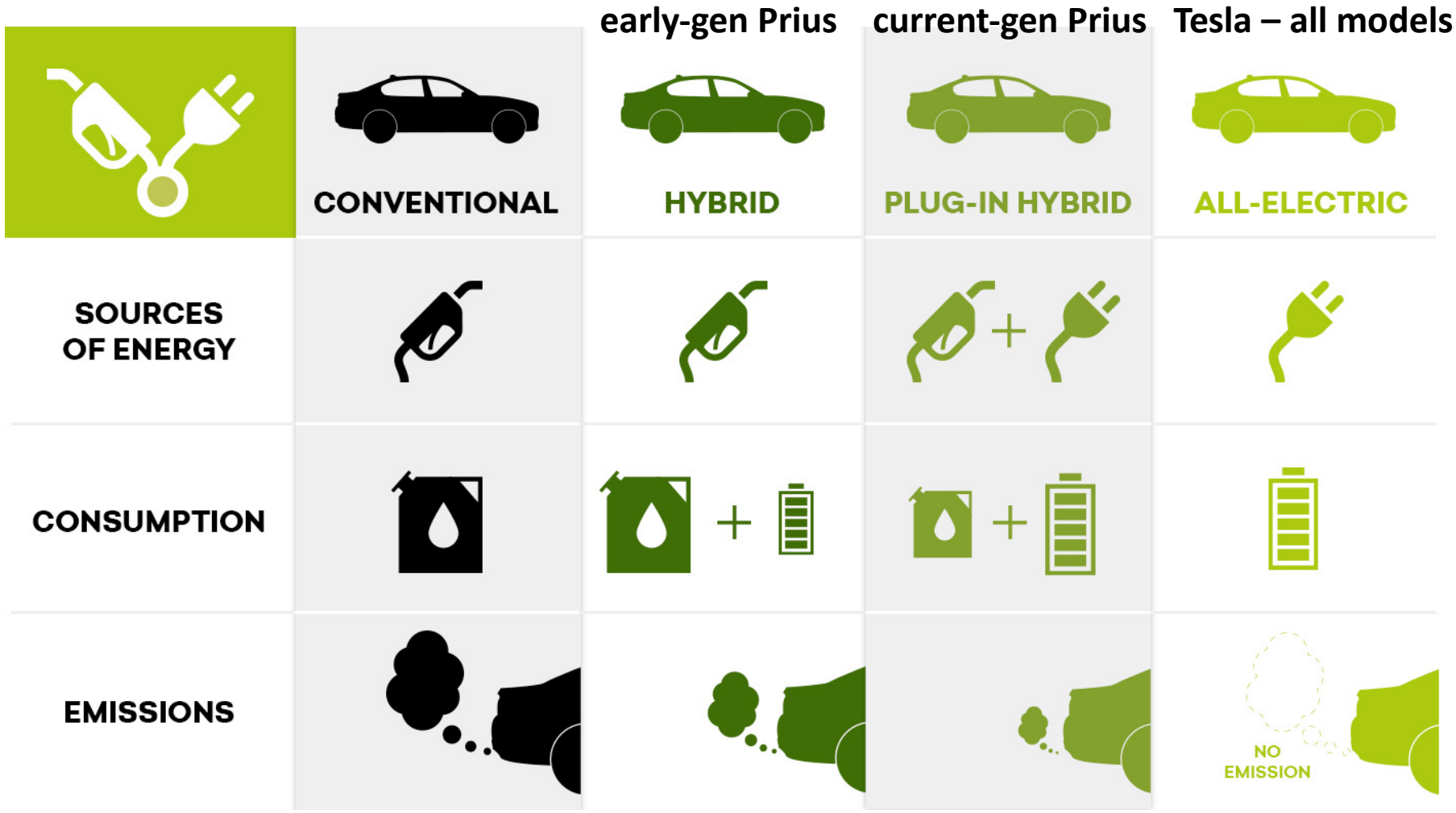
## Technology Advances

## Environmental Sustainability

# Why EV now?

## Reducing car emissions is essential to prevent further climate change

# From ICE to EV



# Why EV now?

EV costs are continuing to decrease and become more accessible

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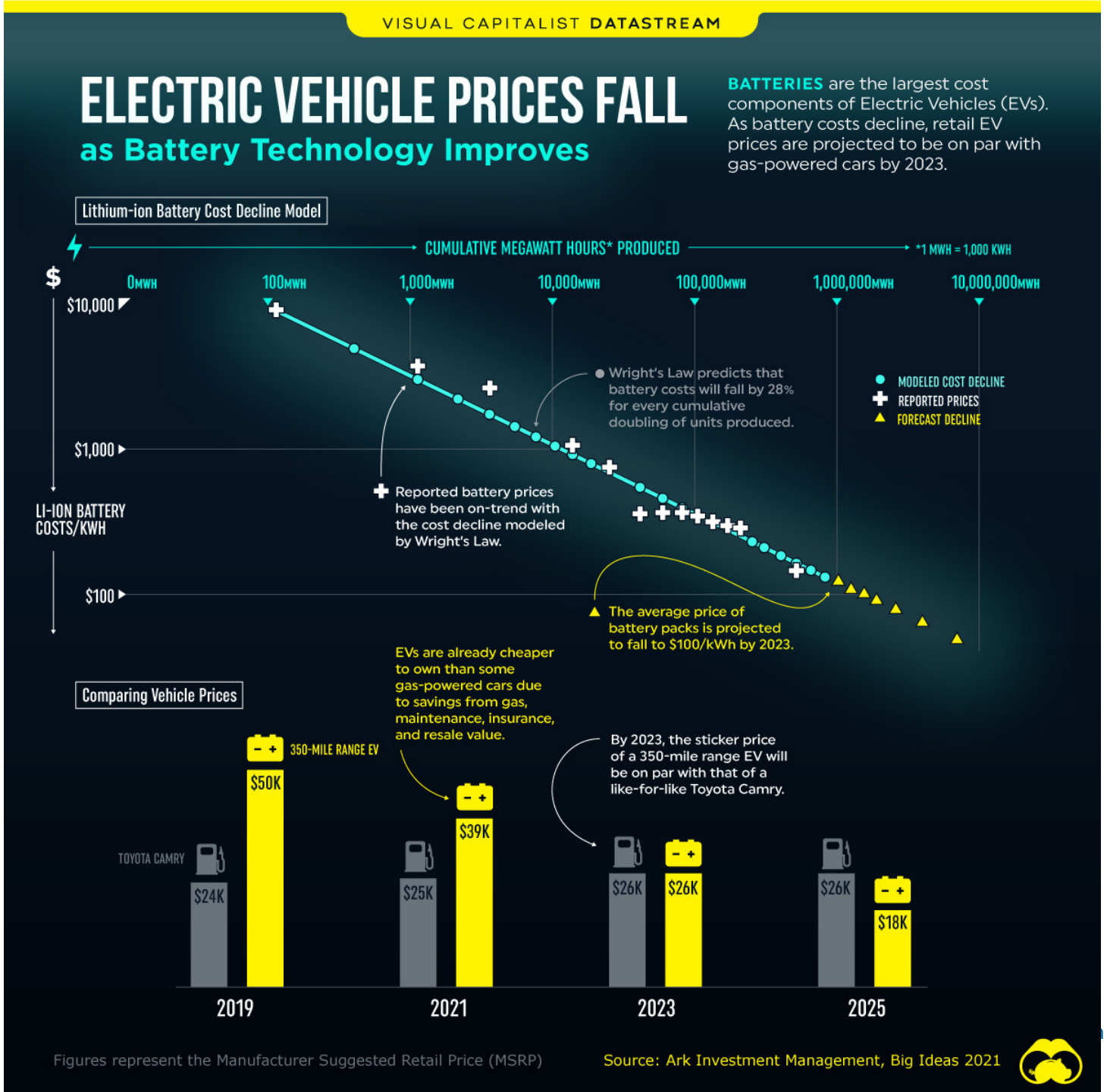

# EV Sales Growth

Annual US auto sales: 14-17M

**BEV**=battery electric vehicle

**PHEV**= plug-in hybrid electric vehicle

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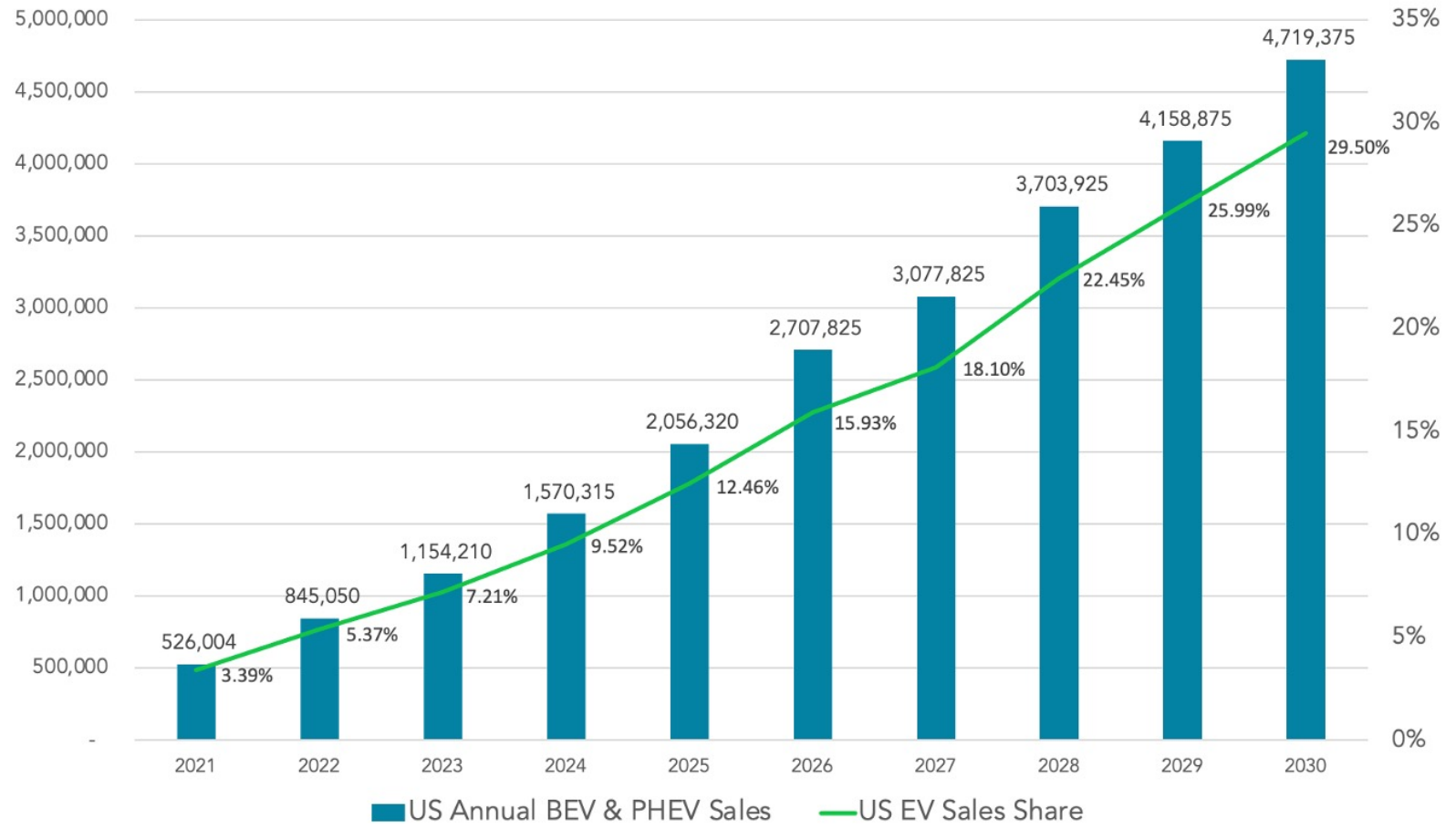
## US EVs (BEV & PHEV) Sales & Sales Share Forecast: 2021-2030




Historical Sales Data: GoodCarBadCar.net, InsideEVs, IHS Markit / Auto Manufacturers Alliance, Advanced Technology Sales Dashboard | Research & Chart: Loren McDonald/EVAdoption

# EV Adoption Rate

"Last year, electric vehicles accounted for about 2 percent of all car sales. This summer, that number jumped to nearly 5 percent of light-duty vehicles like SUVs and sedans and more than 20 percent of all passenger vehicles sales, according to recent data" (Skibell).

EVs account for 2.5% of vehicle market share

1 in every 40 new cars registered are all electric

# Limiting Factors

to EV adoption

- **EV vs. ICE vehicle price:** avg. >$50K
- **Charging time**: 30 min.-8 hrs.
- **Driving range**: 250 miles (median)
- **Charging infrastructure***
- **EV model choices** (next)

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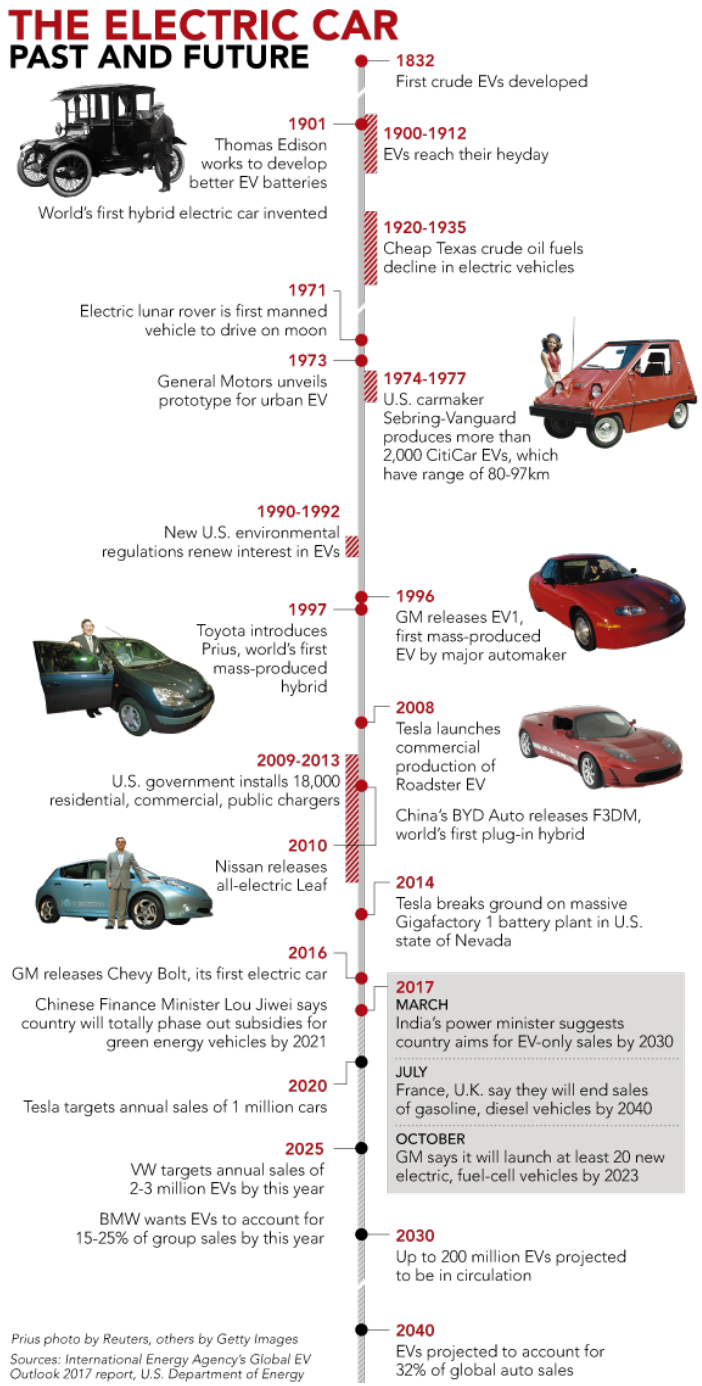
# The Future of Auto-Mobility is EV

# EV History

From the dawn of the automobile to the future

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# Automotive OEM EV Product Pipeline Targets

| Original equipment manufacturer | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| BMW Group | | | 25 | | 15-25% | | | | | 10 |
| BAIC Group | 2 | | | | 1.3 | | | | | 50% |
| Changan Automobile (Group) | | | | | 33 | | | | | |
| Daimler | | 10 | | | 25% | | | | | 50% |
| Dongfeng Motor Co | 1 | 30% | 1 | | 1 | | | | 1 | 1 |
| FAW | | | | | 40% | | | | | 60% |
| Ford | | 40 | | | | 100%* | | | | |
| GM Group | | | 22 | | 30 | 1 | | | | 1 |
| Honda | | | | | | | | | | 40%ᵀ |
| Hyundai-Kia | | | | | 1 | | | | | |
| | | | | | 29 | | | | | |
| Mazda | | 1 | | | | | | | | 5% |
| Renault-Nissan | | 20 | | | | | | | | |
| | | 20% | | | | | | | | |
| Maruti Suzuki | 1 | | | | | | | | | 1.5 |
| SAIC | | | | | 30% | | | | | 30 |
| Stellantis | | | | | 38%* | | | | | 70%* |
| | | | | | 31%** | | | | | 35%** |
| Toyota Group | 1 | | | | 15 | | | | | >1 |
| Volkswagen | | | | | 20% | | | | | 70%* |
| | | | 1 | | 3 | | | | 26 | 50%** |
| | | | | | 75 | | | | | |
| Volvo (Geely Group) | 1 | 1 | 1 | 1 | 50% | | | | | 100%* |

- % of sales electric
- Annual sales (million)
- New EV models (number)
- Cumulative sales (million)

* European market only
** Chinese and US markets only
ᵀ Includes both EVs and FCEVs

# AUTOMAKERS' EV PLANS & COMMITMENTS

Sell zero-emission models only by 2035
Make all global operations & vehicles carbon neutral by 2040

Invest USD 29B in EVs & autonomous vehicles through 2025

Spend USD 84B to bring in 300 EV models to market by 2030

Sell EVs only by 2030 and phase out ICE car models

Increase EV investment to EUR 12B by 2025

Unveil two new EVs in 2021 for the US market

*Last updated: June 2021*

# How Green is My Parking Lot?

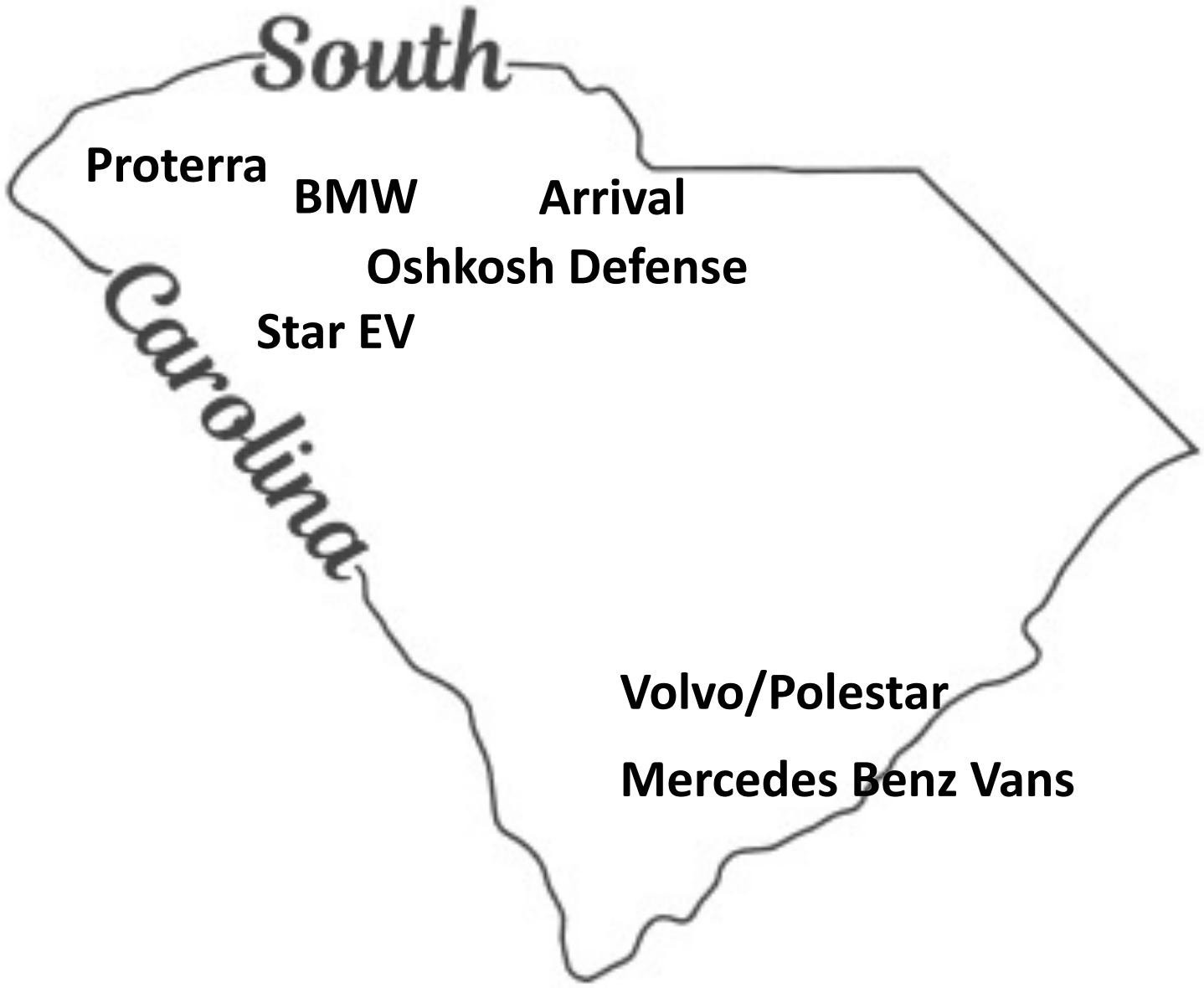
*Green Car Journal* has been presenting its "Green Car Awards" since 2005.
Something happened this year that has never happened before in the award's 17-year history:
All of the vehicles named are electric vehicles.
They are:

- 2022 Green Car of the Year – Audi Q4 e-tron
- 2022 Luxury Green Car of the Year – Lucid Air
- 2022 Urban Green Car of the Year – Chevrolet Bolt EUV
- 2022 Commercial Green Car of the Year – BrightDrop EV600
- 2022 Green SUV of the Year – Hyundai IONIQ 5
- 2022 Performance Green Car of the Year – Tesla Model S Plaid

Earlier awards went to such things as hybrids and even diesels.
Now there is a sufficient number of EVs to fill out the categories.
This may be the proverbial tipping point.

# South Carolina

Leading the EV manufacturing future!

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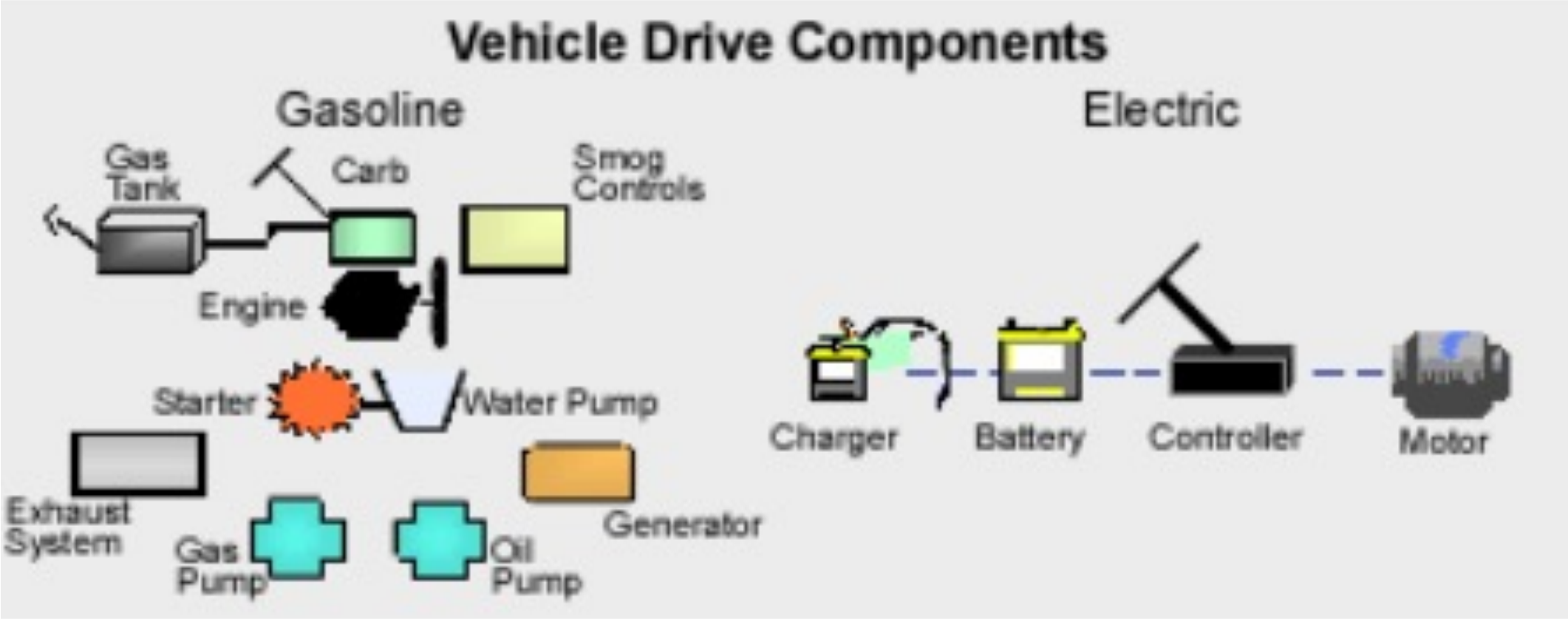
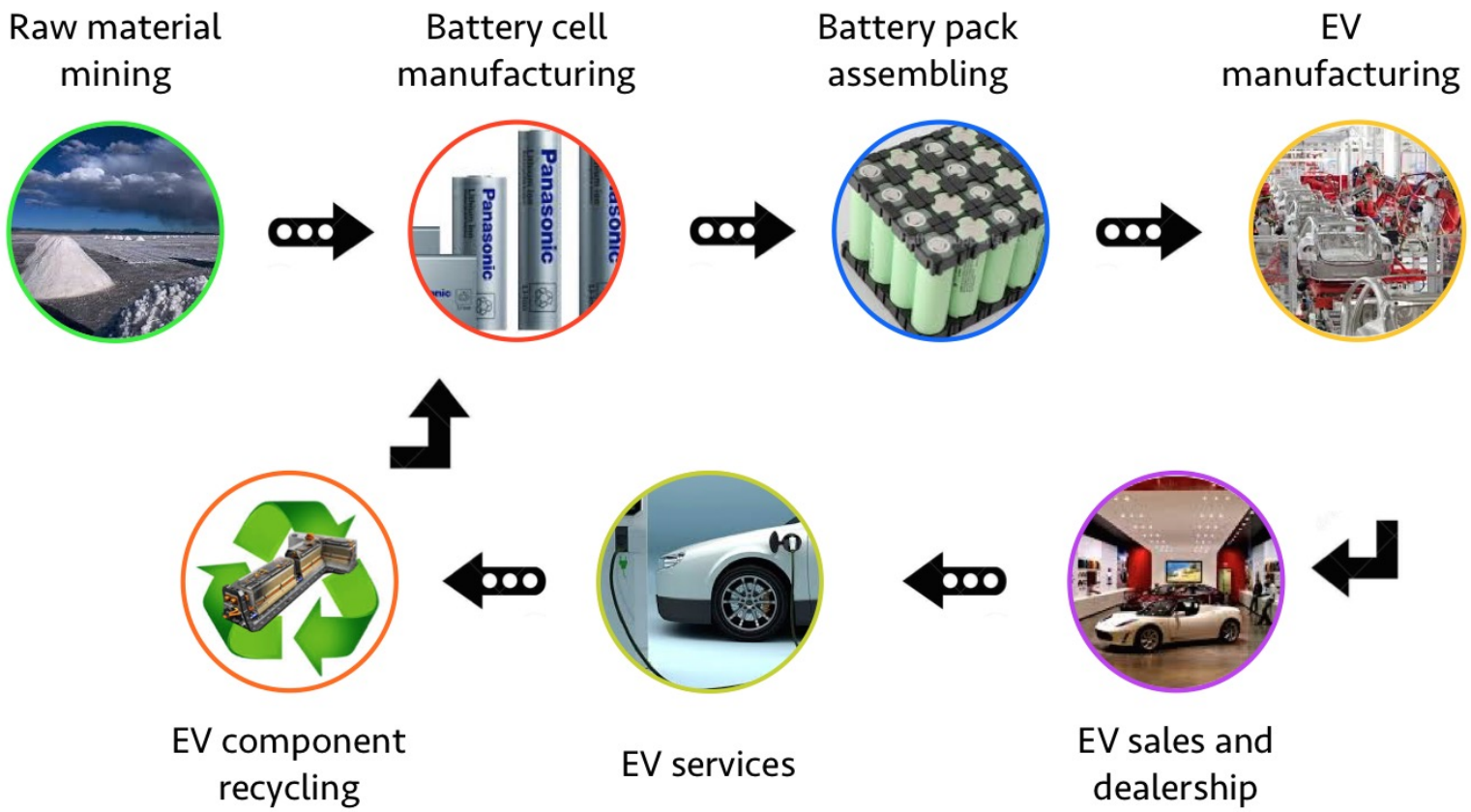
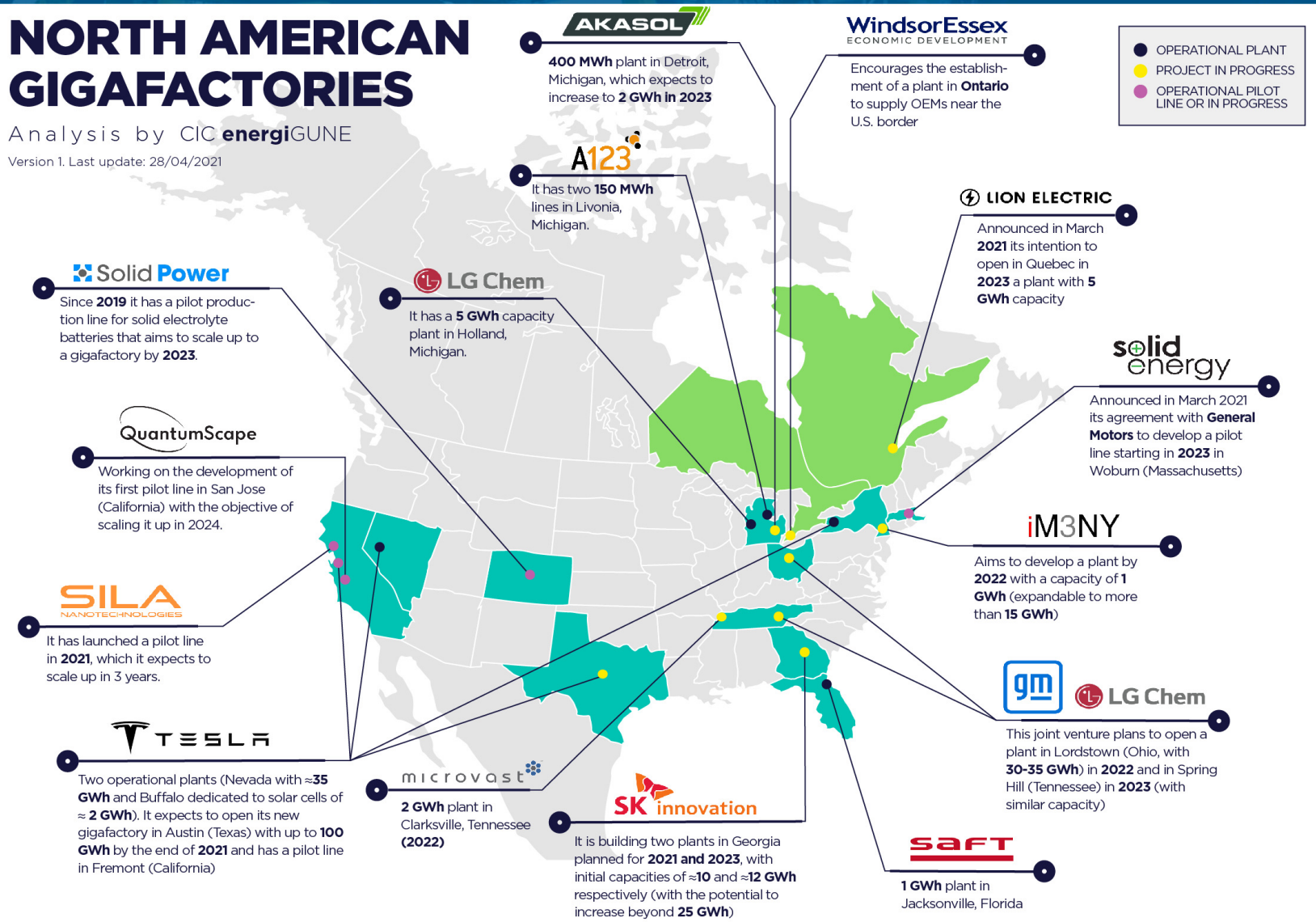
# ICE vs. EV “Drivetrain”



# Vertical Re-Integration of Automotive Supply Chain



# Localizing EV Battery Manufacture



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# Shifting Sands in Auto Retail

**60% of buyers are open to buying their next vehicle online**

**80% of people use internet to do research online before purchasing a new car**


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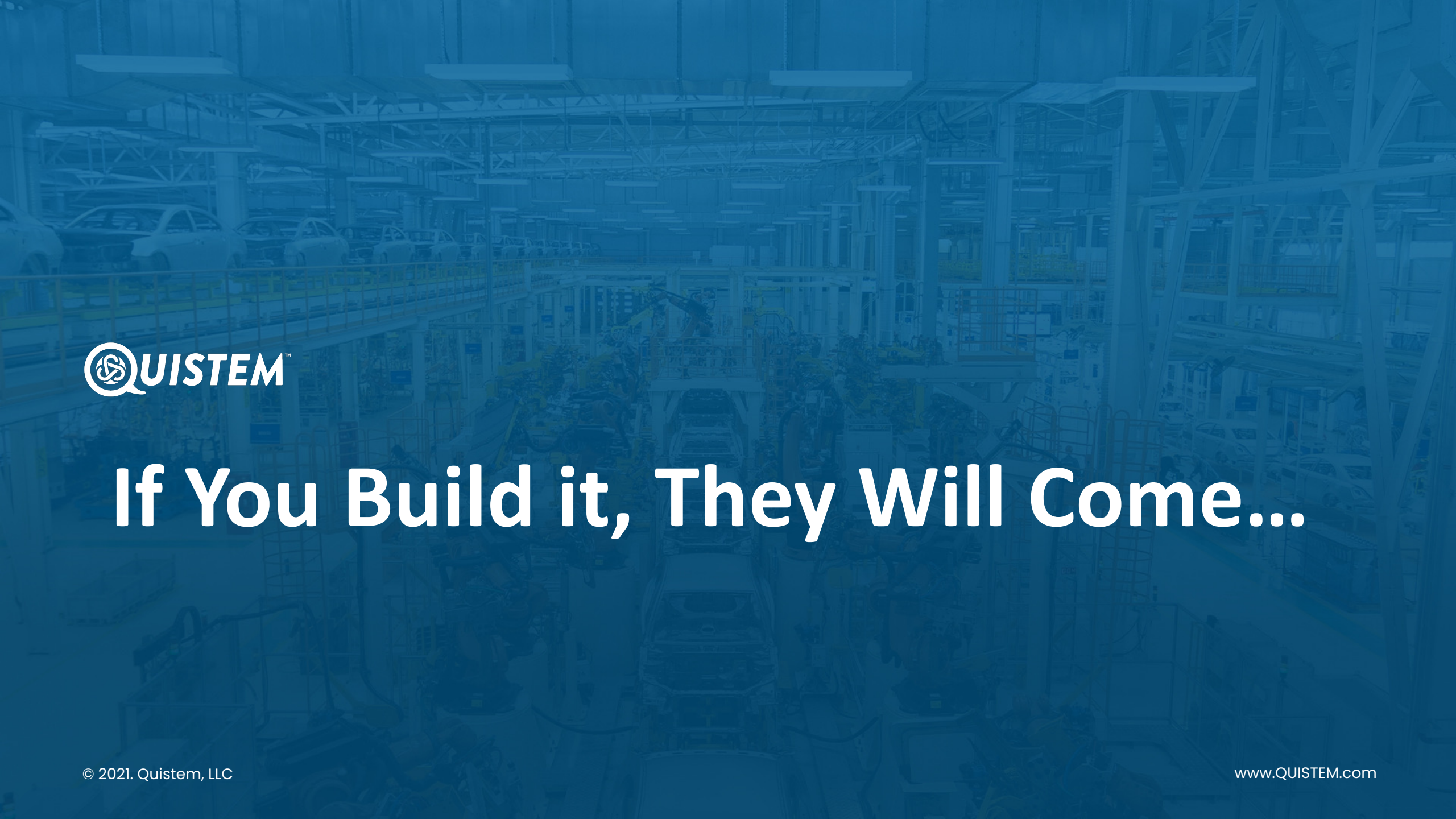
# And OEMs are responding!

Many OEMs are accepting online reservations for new EV models

# EV Industry Initiatives

- ZETA, (Zero Emission Transportation Association) is an industry-backed coalition advocating for 100% of vehicles sold by 2030 to be EVs (www.ZETA2030.org)
- Alliance for Automotive Innovation "Electric Vehicle Agenda" (www.autosinnovate.org)
- Electrification Coalition facilitates widespread adoption of EV technology (www.electrificationcoalition.org)
- North Carolina and twelve other states are a part of the Transportation and Climate Initiative (TCI) who's goal is to "to improve transportation, develop the clean energy economy and reduce carbon emissions from the transportation sector." (www.transportationandclimate.org)



# If You Build it, They Will Come…

# Demographics of Early EV Adopters

Source: Alternative Fuels Data Center and

Pew Research Center (June 3, 2021)

4390 EV registrations in South Carolina (as of December 31, 2020)

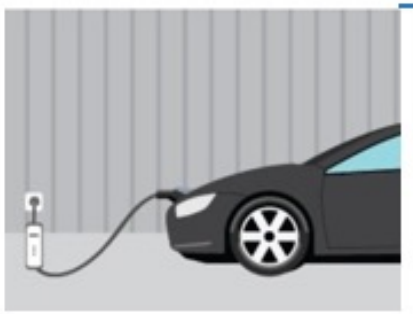
4 in 10 Americans would consider buying an EV

Millennials are most likely (47%)

72% who currently own a hybrid or EV would consider buying an EV

# EV Charging Infrastructure

# Types of EV Charging

| | | Range | Application |
|---|---|---|---|
| **Level 1** |  | 2 to 5 miles of range per hour | • Single Family Homes<br>• Multi-Unit Residential<br>• Condos |
| **Level 2** |  | 10 to 30 miles of range per hour | • Single Family Homes<br>• Multi-Unit Residential<br>• Workplace<br>• Fleet<br>• Public |
| **Level 3 (Direct Current Fast)** |  | 150 to 350+ miles of range per hour | • Fleet<br>• Public<br>• Multi-Unit Residential |

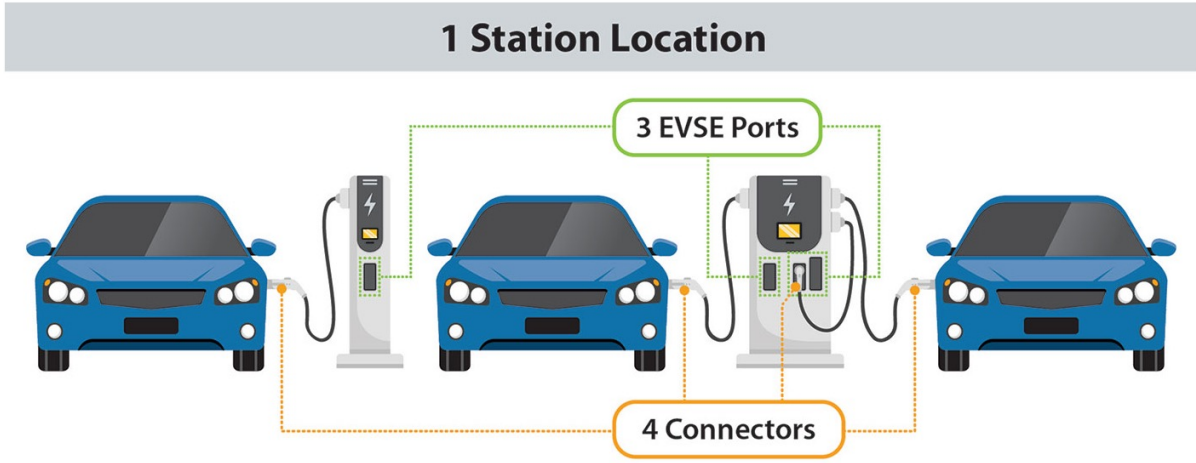
# EV Charging

## Public Infrastructure

### Charging Infrastructure Terminology

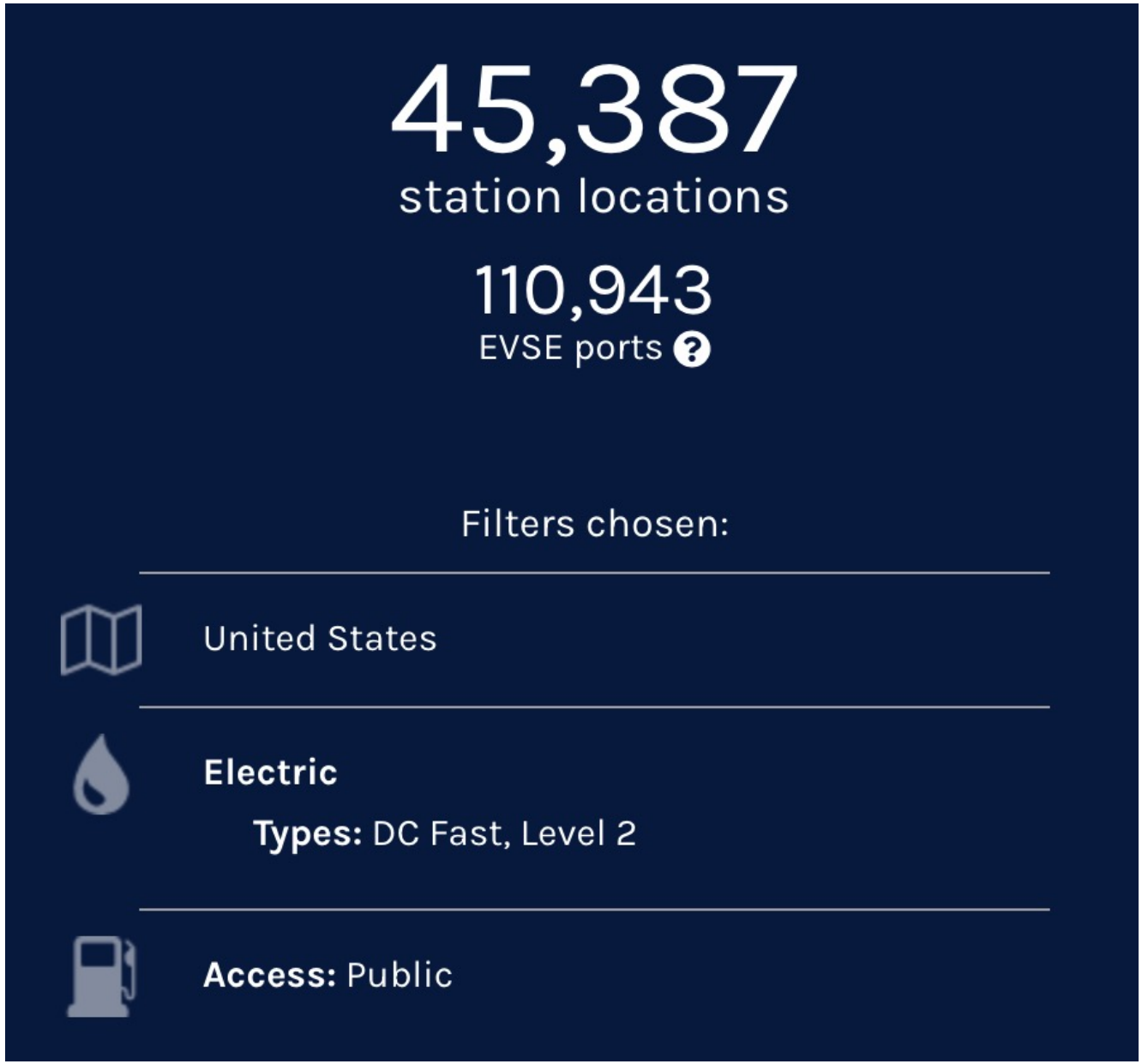
The Alternative Fueling Station Locator uses the following charging infrastructure definitions:

- **Station Location:** A station location is a site with one or more EVSE ports at the same address. Examples include a parking garage or a mall parking lot.
- **EVSE Port:** An EVSE port provides power to charge only one vehicle at a time even though it may have multiple connectors. The unit that houses EVSE ports is sometimes called a charging post, which can have one or more EVSE ports.
- **Connector:** A connector is what is plugged into a vehicle to charge it. Multiple connectors and connector types (such as CHAdeMO and CCS) can be available on one EVSE port, but only one vehicle will charge at a time. Connectors are sometimes called plugs.



# US Public EV Charging Station Statistics

Compared to over 150000 gas stations

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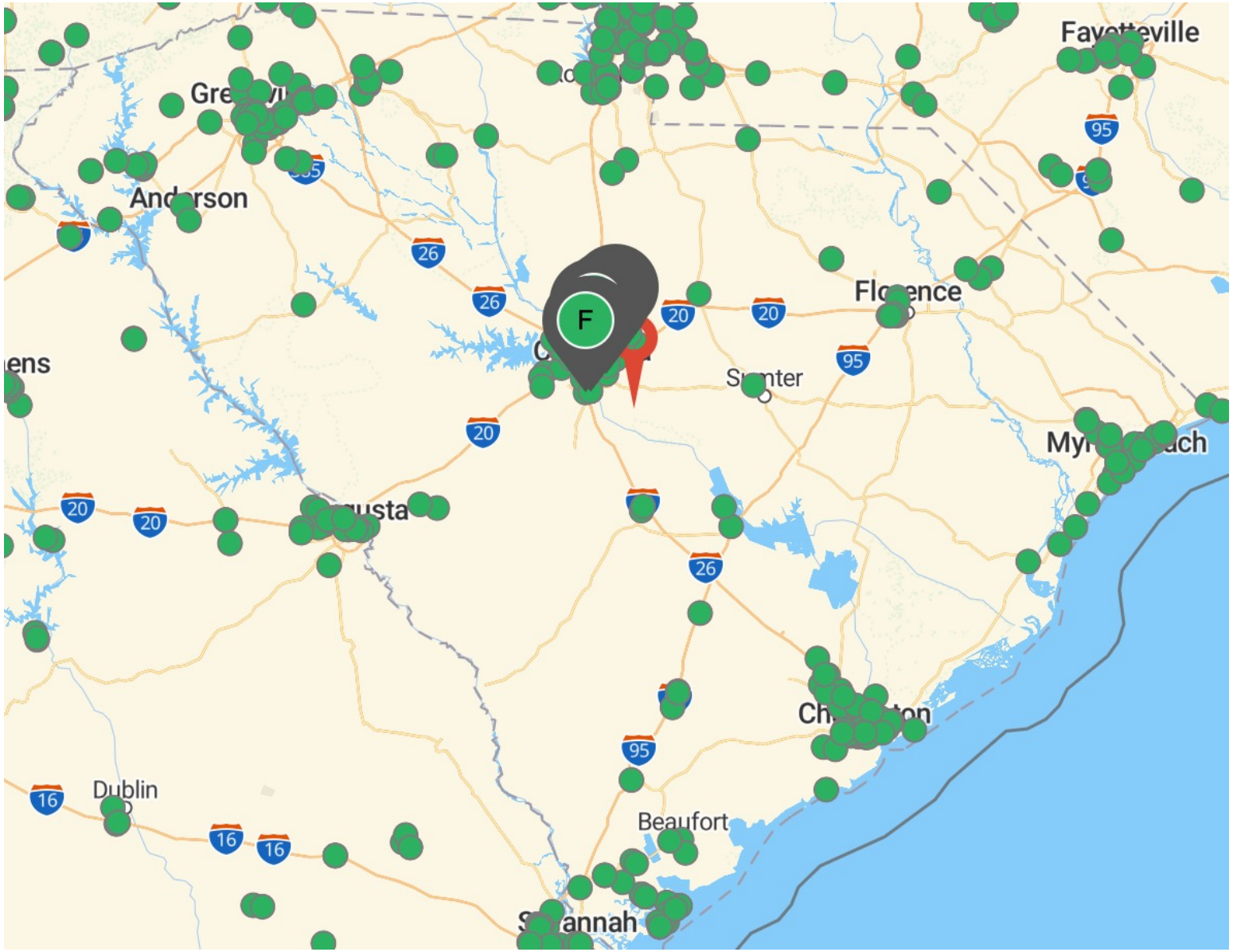
# South Carolina current EV infrastructure

335 public EV station locations

775 EVSE ports

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# Technical Considerations:  Charging Connectors

# Technical Considerations

Charging stations may require charging adaptors:

**J1772**

- Can be used by every EV sold in North America (ex GM Chevy Volt)

**CHAdeMO**

- Typically used for level 3 charging
- Used by:
  - Nissan Leafs
  - Mitsubishi Outlanders
  - some Kia and Hyundai cars

# EV Infrastructure Opportunities

# EV Charging has Positive Impact on Your Community

| | | | |
|---|---|---|---|
| Clean air commitment | Lower driving cost for community | Towards cleaner transportation | Environmental justice |
| Increased property values | Achieve climate change goals in your community | Resilience in local energy grid | Great PR for your community |

Source: ENEL JuiceBlog (August 26, 2020)

# Business Benefits of EV Charging Stations

- Attract customers
- Recognition
- Unique positioning
- Develop customer relationships
- Reduce your carbon footprint
- Demonstrate your commitment to environmental responsibility & sustainability
- Electrify your fleet
- Be an early adopter

# Public EV Charging Station Costs

## Level 2 Charger

- AC charging
- $10000 + installation
- ChargePoint as a service

## Level 3 Charger

- DC Fast charging
- $50000+ installation

# Nearby EV Adoption Case Studies

**City of Newberry (Newberry County Library parking lot)**: The location for the EV charging station was chosen for its walkability to just about anything in downtown Newberry – from shopping, dining, entertainment and more, allowing those waiting on vehicles to charge the opportunity to explore what Newberry has to offer. The charging station utilizes a Level 2 Siemens 50AMP charger, third generation, and has a J-1772 charging plug, making it universal for use with any electric vehicle. Two vehicles can charge at the station at a time, with it taking between two to four hours on average to fully charge a vehicle. This station is the first of its kind in the state. Initially, the charging service will be provided at no cost to users to encourage the use of electric vehicles.

**Plug-in SC Incentive program**

# US Dept. of Energy

## Alternative Fuels Data Center

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# South Carolina Laws and Incentives

Listed below are incentives, laws, and regulations related to alternative fuels and advanced vehicles for South Carolina. Your Clean Cities coordinator at Palmetto Clean Fuels Coalition can provide you with information about grants and other opportunities. You can also access coordinator and other agency contact information in the points of contact section.

**Filter by Technology/Fuel**

EVs

**Filter by Utility**

All selected

*9 results filtered from 20 items*

## Laws and Incentives

VIEW ALL | ADVANCED SEARCH

Information in this list is updated annually after South Carolina's legislative session ends.
*Last Updated October 2020*

**State Incentives**

- Alternative Fuel Project Grants
- Alternative Fuel Vehicle (AFV) Revolving Loan Program for Public Entities
- Alternative Fuel Vehicle (AFV) Revolving Loan Program for Private Entities

**Utility/Private Incentives**

- Plug-in Electric Vehicle (PEV) Charging Rebate - Duke Energy
- Electric Vehicle Supply Equipment (EVSE) Rebate - Santee Cooper added 10/22/2021

**Laws and Regulations**

- Plug-In Electric Vehicle (PEV) Cost Recovery
- Alternative Fuel Vehicle Fee
- State Agency Preference for Alternative Fuel and Advanced Vehicles
- Public Utility Definition updated 11/12/2021

### South Carolina Information

Find information about alternative fuels and advanced vehicles in South Carolina.

### Something Missing?

Email the Technical Response Service or call 800-254-6735.

## Expired, Repealed, and Archived Laws and Incentives

View a list of expired, repealed, and archived laws and incentives in South Carolina.

## Points of Contact

Get contact information for Clean Cities coalitions or agencies that can help you with clean transportation laws, incentives, and funding opportunities in South Carolina.

## Clean Cities Coalitions

South Carolina is home to the following Clean Cities coalitions:

- Palmetto Clean Fuels Coalition

# Other Available Funding

- House sends infrastructure bill with EV provisions to Biden: The chamber passed the biggest U.S. infrastructure package in decades, which includes $7.5 billion for electric vehicle charging stations. The proposal for a tax credit for union-built EVs has been delayed.
- **Electrify America ZEV Investment Plan:** cycle 3 January, 2022-July, 2024; funded in part from VW emissions settlement with EPA
- **Duke Energy ET, (Electric Transportation) pilot programs:** fast charging and residential EV charging programs

- **Offer local businesses to ”sponsor a charger”**

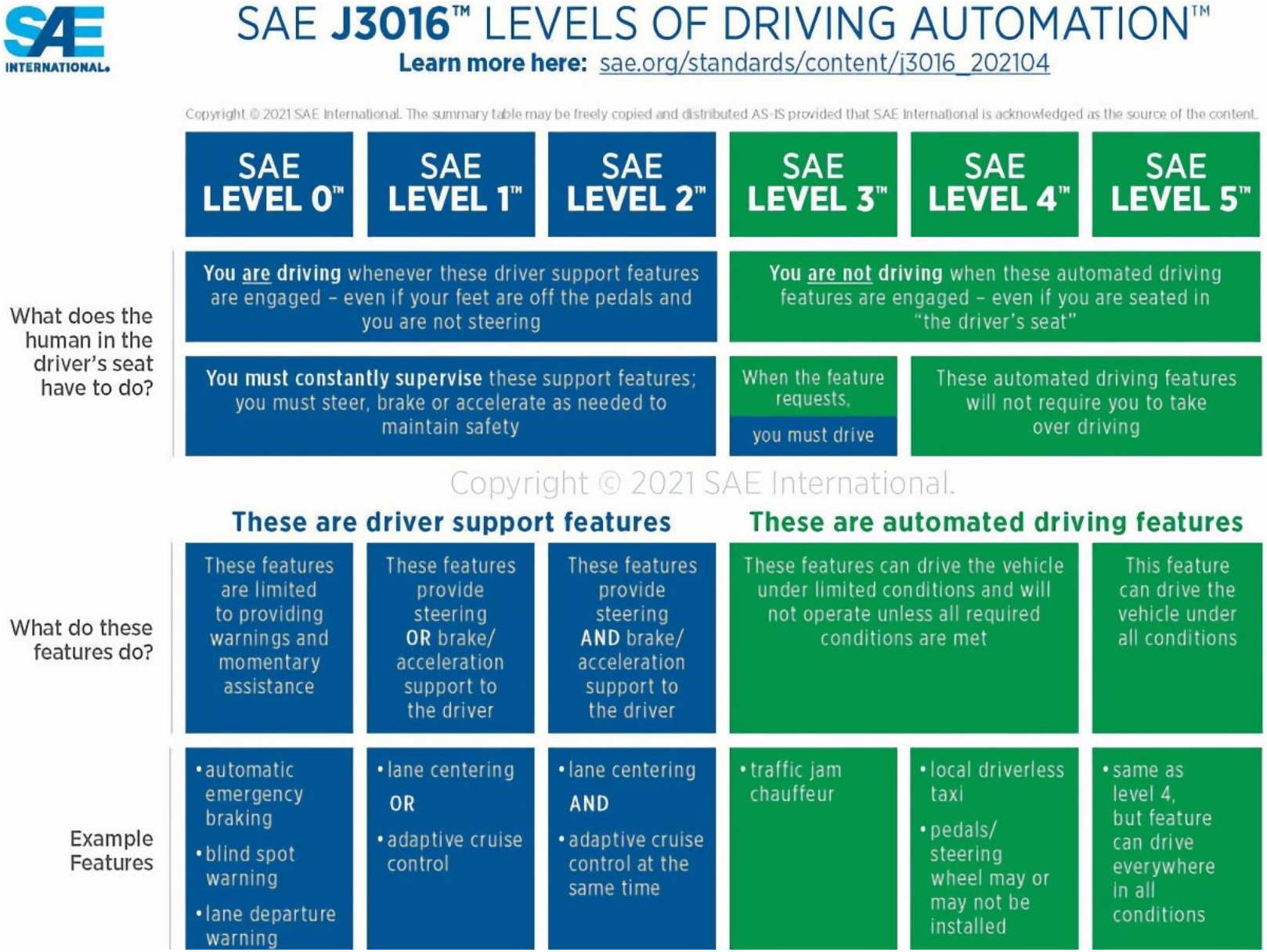
# Addressing Lost Revenue from Gasoline Tax

- Most states have special EV fees paid with registration in place to account for this loss in revenue
  - SC has a semiannual fee of $120 for EVs and $60 for hybrids
  - NC has an annual fee of $130 for EVs


# Imagine an AV Future

# Automated Driving

## Technology continuum



SAE INTERNATIONAL

# SAE J3016™ LEVELS OF DRIVING AUTOMATION™

**Learn more here:** sae.org/standards/content/j3016_202104



| | SAE LEVEL 0™ | SAE LEVEL 1™ | SAE LEVEL 2™ | SAE LEVEL 3™ | SAE LEVEL 4™ | SAE LEVEL 5™ |
|---|---|---|---|---|---|---|
| What does the human in the driver's seat have to do? | **You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering | | | **You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat" | | |
| | **You must constantly supervise** these support features; you must steer, brake or accelerate as needed to maintain safety | | | When the feature requests, you must drive | These automated driving features will not require you to take over driving | |
| | **These are driver support features** | | | **These are automated driving features** | | |
| What do these features do? | These features are limited to providing warnings and momentary assistance | These features provide steering **OR** brake/ acceleration support to the driver | These features provide steering **AND** brake/ acceleration support to the driver | These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met | | This feature can drive the vehicle under all conditions |
| Example Features | • automatic emergency braking<br>• blind spot warning<br>• lane departure warning | • lane centering **OR**<br>• adaptive cruise control | • lane centering **AND**<br>• adaptive cruise control at the same time | • traffic jam chauffeur | • local driverless taxi<br>• pedals/ steering wheel may or may not be installed | • same as level 4, but feature can drive everywhere in all conditions |



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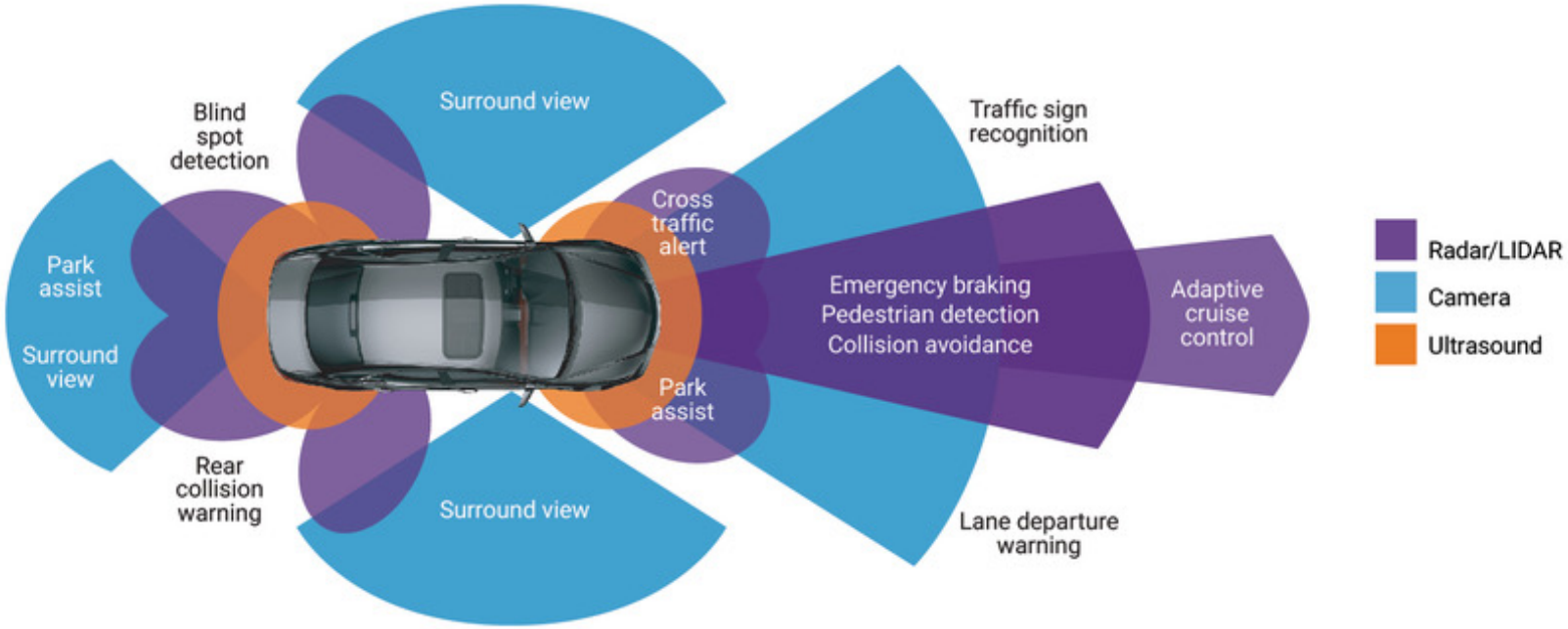
# ADAS (Advanced Driver Assistance Systems: The gateway to autonomous driving

**Nearly all vehicles sold today have one or more ADAS features**



# Current AV Activities:

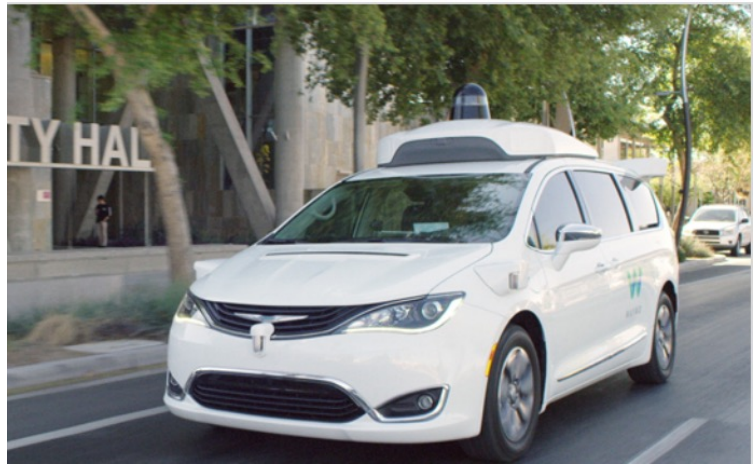
## The Future is Here

**GM's Cruise seeks California permit for robotaxi fares:** Cruise seeks to use as many as 30 autonomous vehicles in a limited geographic area within San Francisco on public roads.

Zoox and Waymo are paving the way towards self driving public Transit

- Ongoing trials in:
  - Las Vegas, Nevada
  - Forester City, California
  - San Francisco, California
  - Phoenix, Arizona


A ZOOX ROBOTAXI. IMAGE SOURCE: ZOOX.



Waymo's autonomously driven Chrysler Pacifica Hybrid minivan on public roads. IMAGE SOURCE: WAYMO

# AV Infrastructure Considerations

- Roadside sensors
- Narrower driving lanes
- Machine-readable signs
- Clear lane markings
- Reliable 5G connection
- Parking facilities no longer needed

# Your Mobility Future:

Developing your Future Mobility Strategy

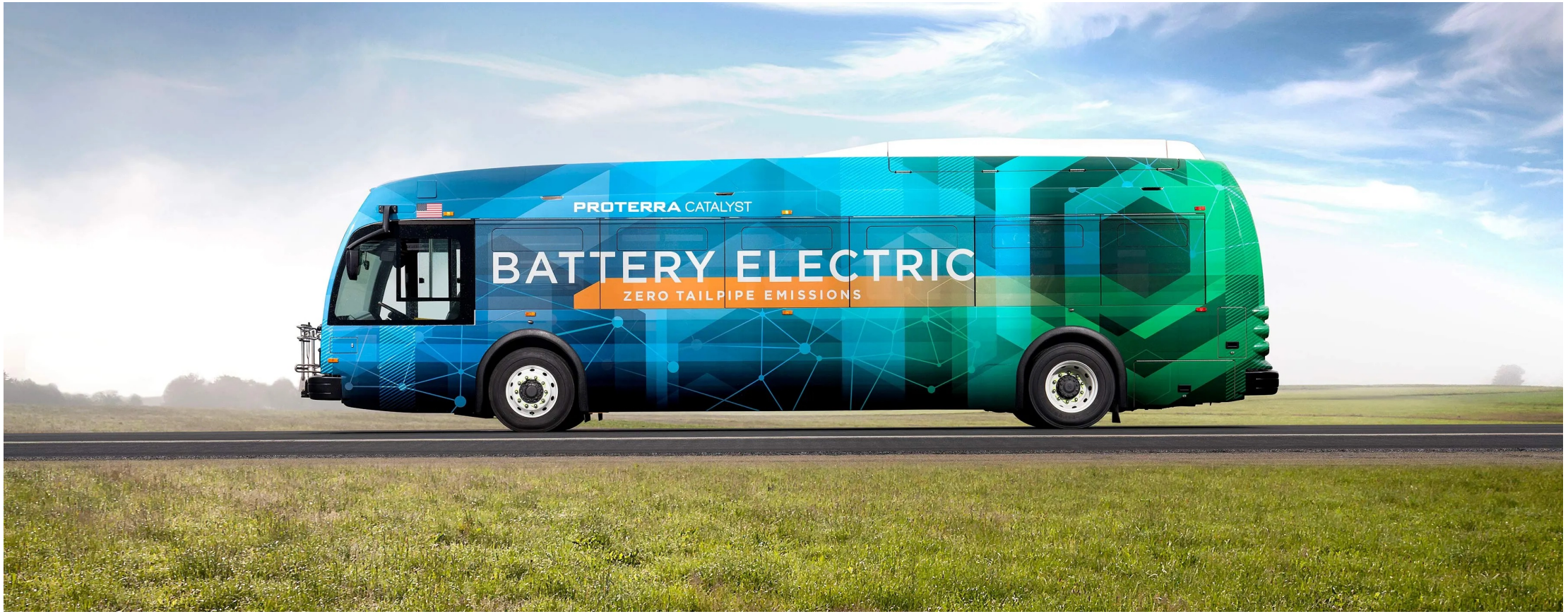
**Mobility is about personal freedom**

What steps will you take to ensure mobility choices are available in your community?

1. Establish a future mobility plan
2. Be an early adopter
3. Leverage available resources/grants/funding
4. Get your community involved
5. Partner with local businesses
6. Envision a future of mobility for all

# Honorable Mention: PROTERRA

(since 2004; over 1000 buses sold)



# Thank you for joining us today

Want to learn more about the future of auto-mobility?

Contact: CathyFisher@Quistem.com

Visit: www.Quistem.com

# Quistem's Core Focus

## Automotive Manufacturers

striving for Excellence in their operations

| | | |
|---|---|---|
| We help organizations seamlessly integrate management systems requirements into the functions & processes of their daily business. | **Transforming management systems into Money-making Machines!** | We distill complex issues into clear insights so you can take targeted action. |

# Sources:


"EV Consumer Behavior." *Fuels Institute.* June. 2021, https://www.fuelsinstitute.org/Research/Reports/EV-Consumer-Behavior/EV-Consumer-Behavior-Report.pdf

Kane, Mark. "US: All-Electric Car Market Share Expands To 2.5% in H1 2021." *Insideevs.* 14 Aug. 2021, https://insideevs.com/news/526699/us-electric-car-registrations-2021h1/

Skibell, Arianna. "EV sales have doubled. Is a 'tidal wave' coming?" *E&E News.* 1 Oct. 2021, https://www.eenews.net/articles/ev-sales-have-doubled-is-a-tidal-wave-coming/

Charging levels graphic: https://bateselectric.com/ev-charging-stations-2/