


Transportation Electrification Landscape

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Drivers:

- Electric vehicle technology is increasingly viable and cost-effective across many use cases
- Mainstream market awareness is at an all-time high
- State policy, incentives, and private investment are driving consumer action
- Infrastructure build-out is happening
- A cleaner grid makes transportation sector decarbonization more potent
- More stakeholders are seeing the benefits (i.e., utilities)

Photo credit: Joe Ryan/The Diamondback

→ Transportation electrification continues to evolve rapidly

Trends

Europe

Strong regulatory support → high consumer adoption and rapid infrastructure growth

- Norway
- Netherlands
- Germany

48%

EV share of all new car sales in China as of the end of 2024; BEVs were 25% of sales last year

11.2 M

China's total EV sales in 2024, 38% increase from the previous year

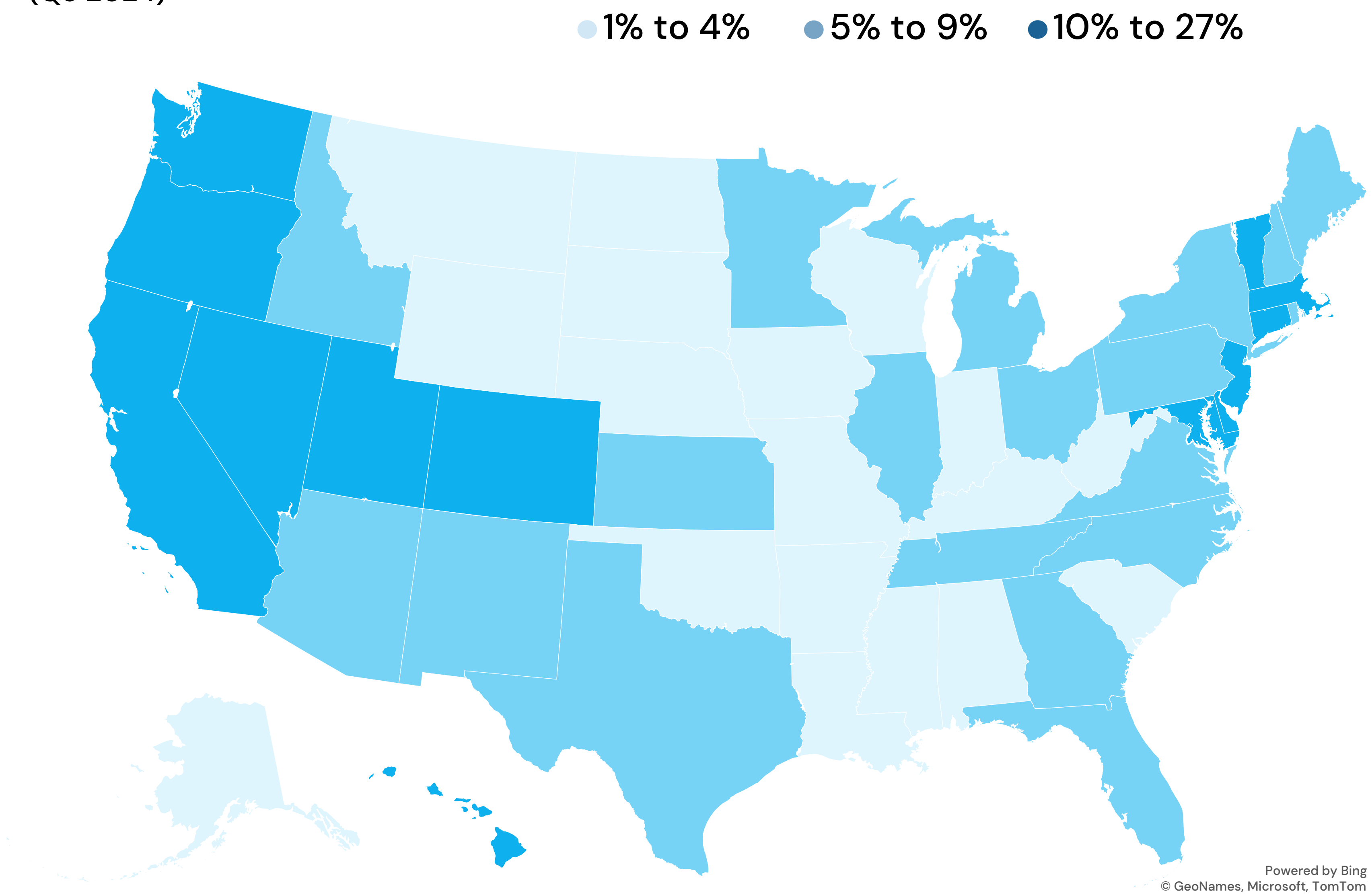
Market leaders

Rank	OEM	Share
1	BYD	34%
2	Geely	8%
3	Tesla	6%

→ Globally, China leads

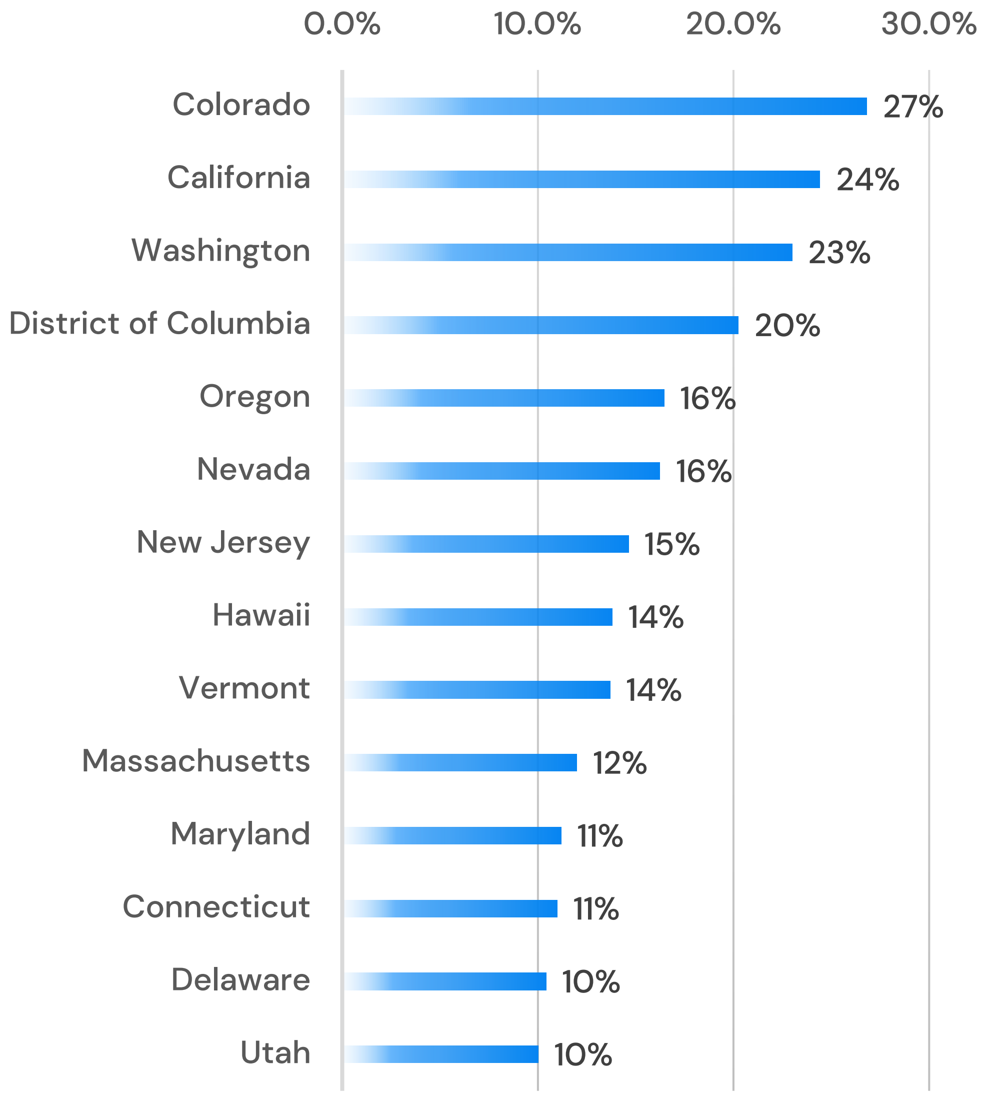
14 states now exceed 10% EV market share

State EV Market Share*
(Q3 2024)



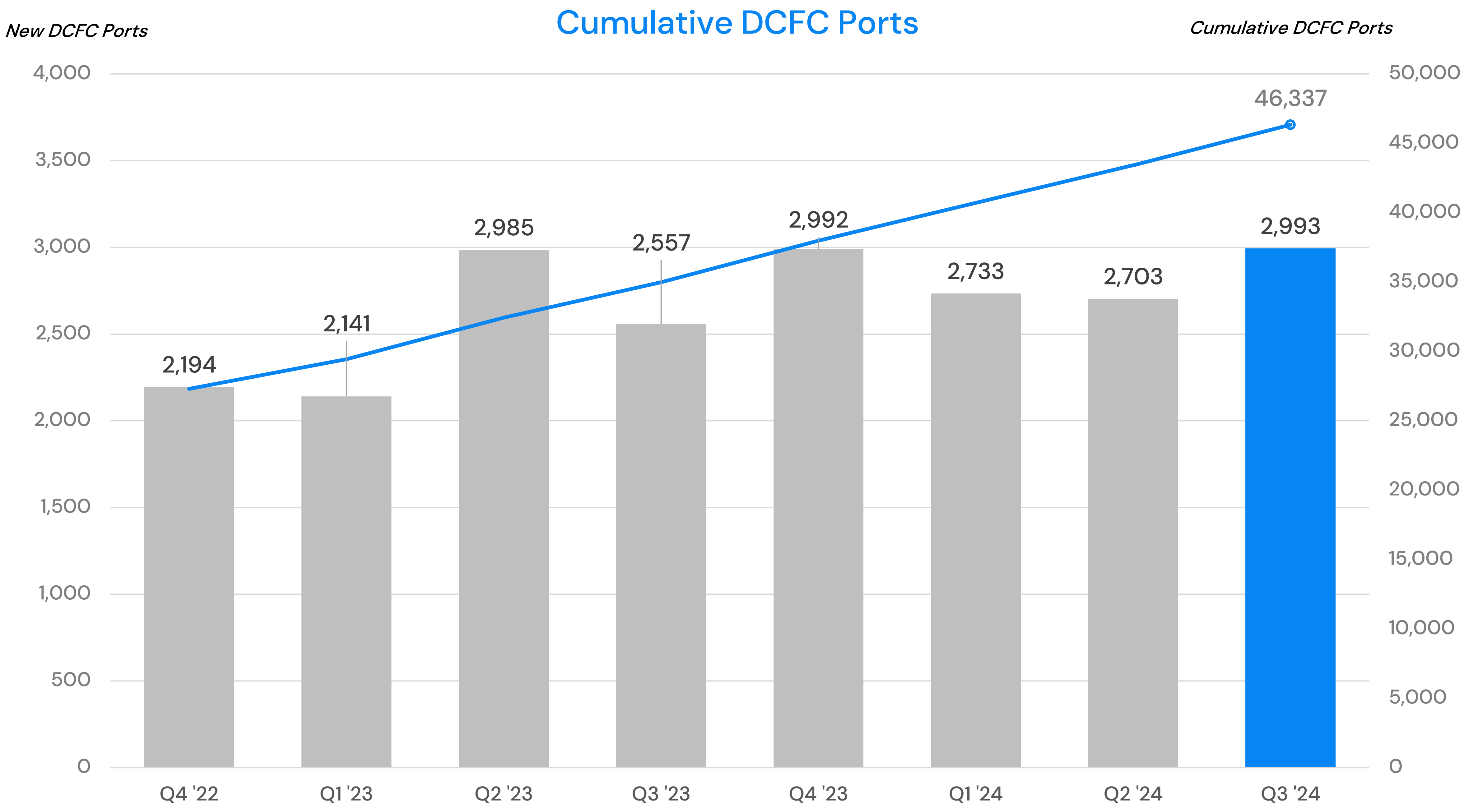
Light-duty sales, includes plug-in hybrid electric vehicles

States Over 10%
(Q3 2024)



Source: [EV Market Dashboard – Atlas EV Hub]

The expansion of public fast charging persists



Source: [EV Charging Deployment – Atlas EV Hub]

Standardization of charging infrastructure is underway

- North American Charging Standard (NACS) = SAE J3400
- Most OEMs intend to adopt J3400, some starting with adapters and then integrated ports
- Technical compatibility does not guarantee a superior customer experience

Source: Ford

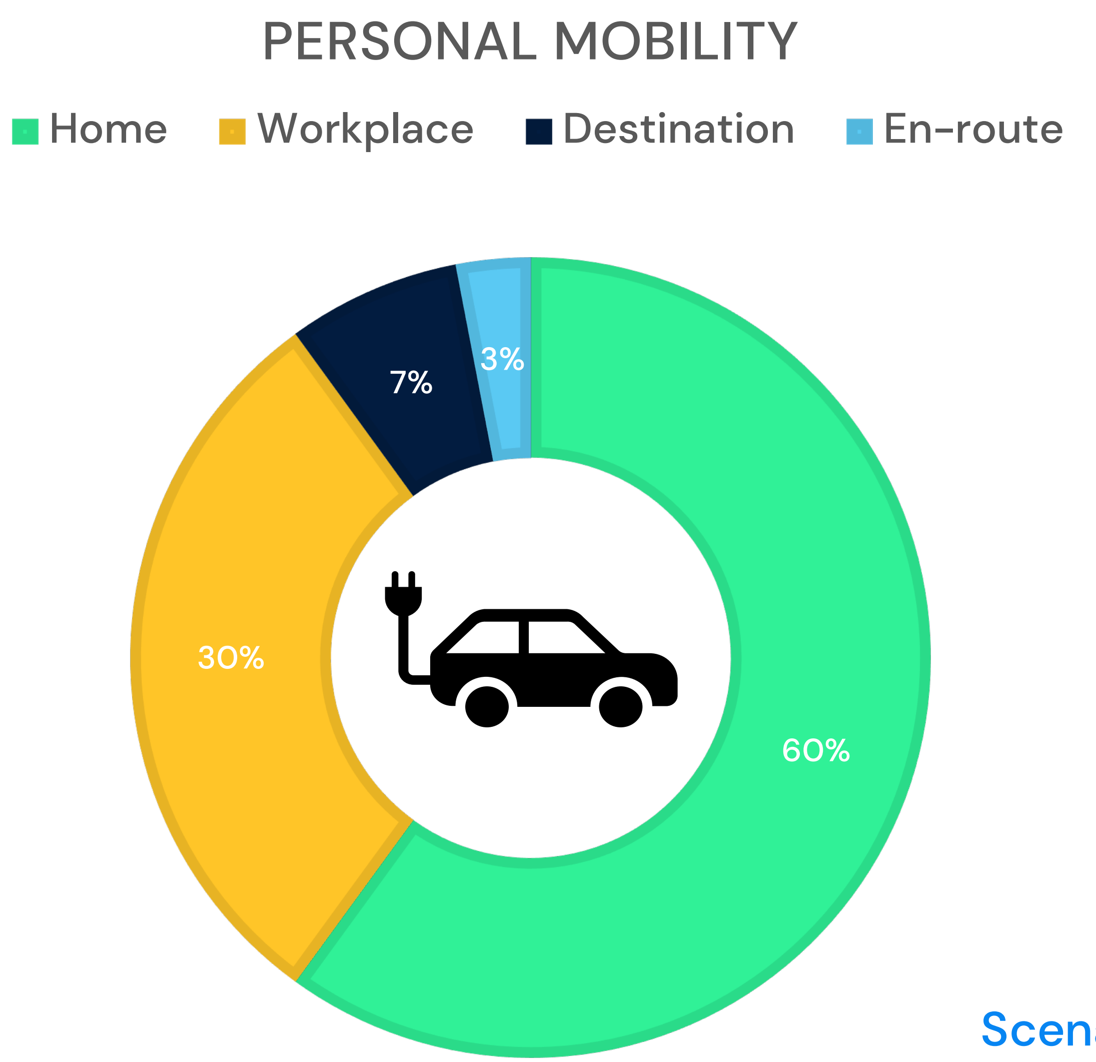
Source: Consumer Reports

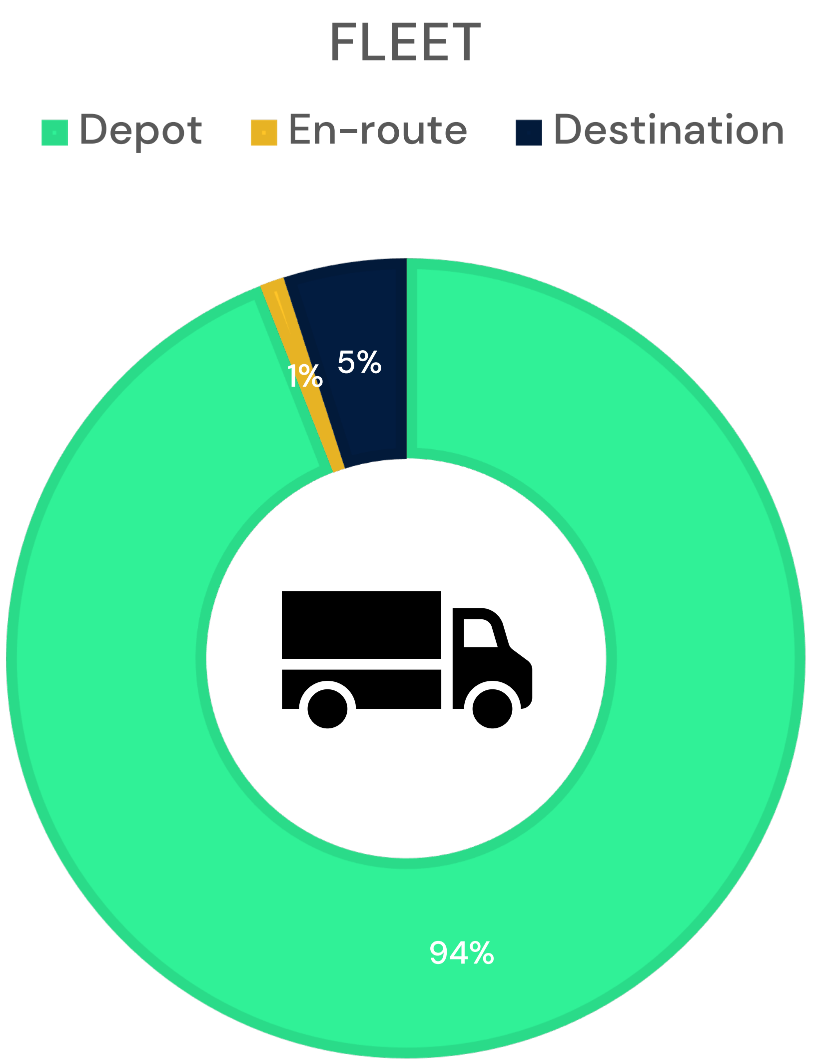
Source: reddit

Funding sources are diversifying

- Federal government
- State/sub-national entities
- Utilities
- Automakers
- Battery producers
- Charging manufacturers/providers

Charging infrastructure needs vary greatly by use case

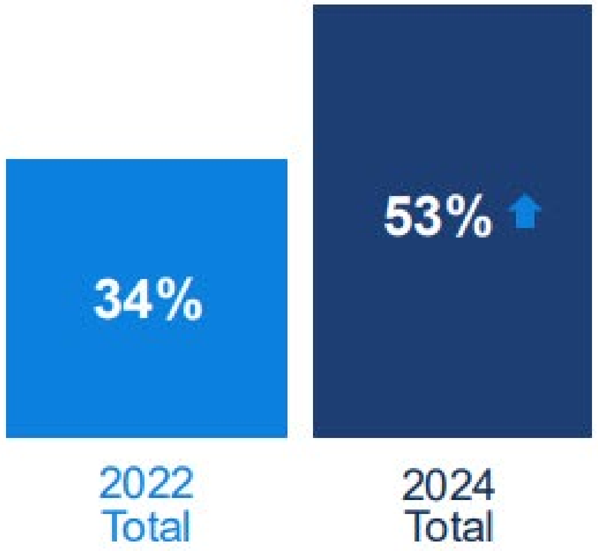




Scenarios are illustrative.
Reality is based on individual needs, regional landscape, etc.

Public and private fleets are increasingly likely to adopt EVs

Likelihood To Acquire EVs During Next Acquisition Cycle
(%Very/Somewhat Likely)



90%
of **EV owners** are likely to acquire a EV during the next acquisition cycle

Among BEV Considerers, **74% are aware of EV incentives.** Nearly half (47%) of those aware believe fleet incentives are HIGHER than retail incentives

87%
Expecting EVs in Fleet in Next Five Years
(Among Total Sample)

Expected EV Share of Average Fleet in Five Years?
Total Sample: 43%
EV Owners: 58%

Source: Cox Automotive, "Future of Fleets: Path to EV Adoption,"

Challenges

We're in a period of peak uncertainty

How will tariffs impact my TCO calculations?

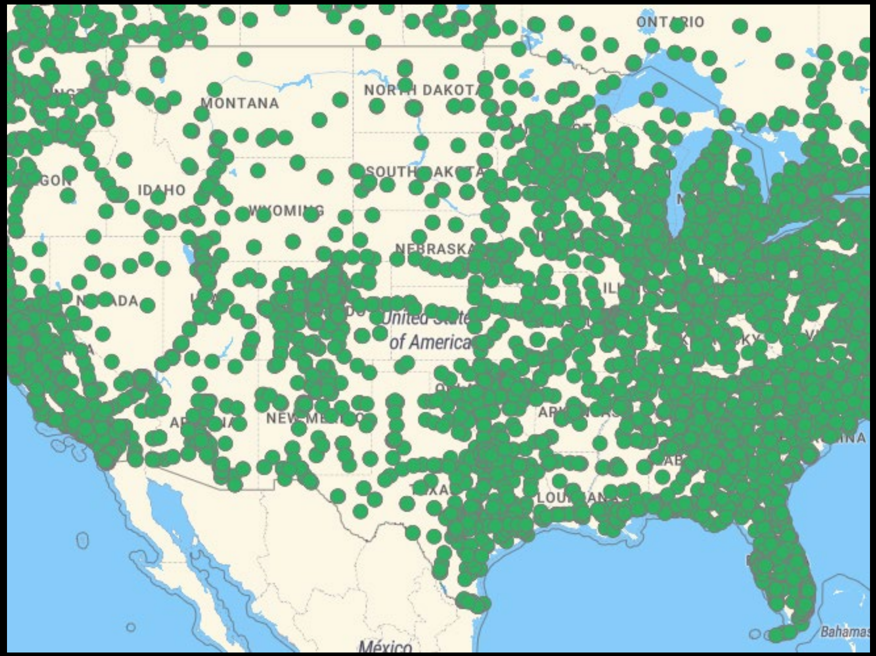
Will my charging network provider be around next year?

Should I expect COVID-like supply chain delays and delivery timelines?

Does the data center boom mean it'll take years to connect to the grid?

U.S. public charging availability

We still have a ways to go to build out a comprehensive public charging network, particularly in rural areas.



181,500

Public Level 2 EV charging ports in the U.S. DOE Alternative Fueling Station Locator as of today*

61,800

Public DC fast chargers in the U.S. DOE Alternative Fueling Station Locator as of today*

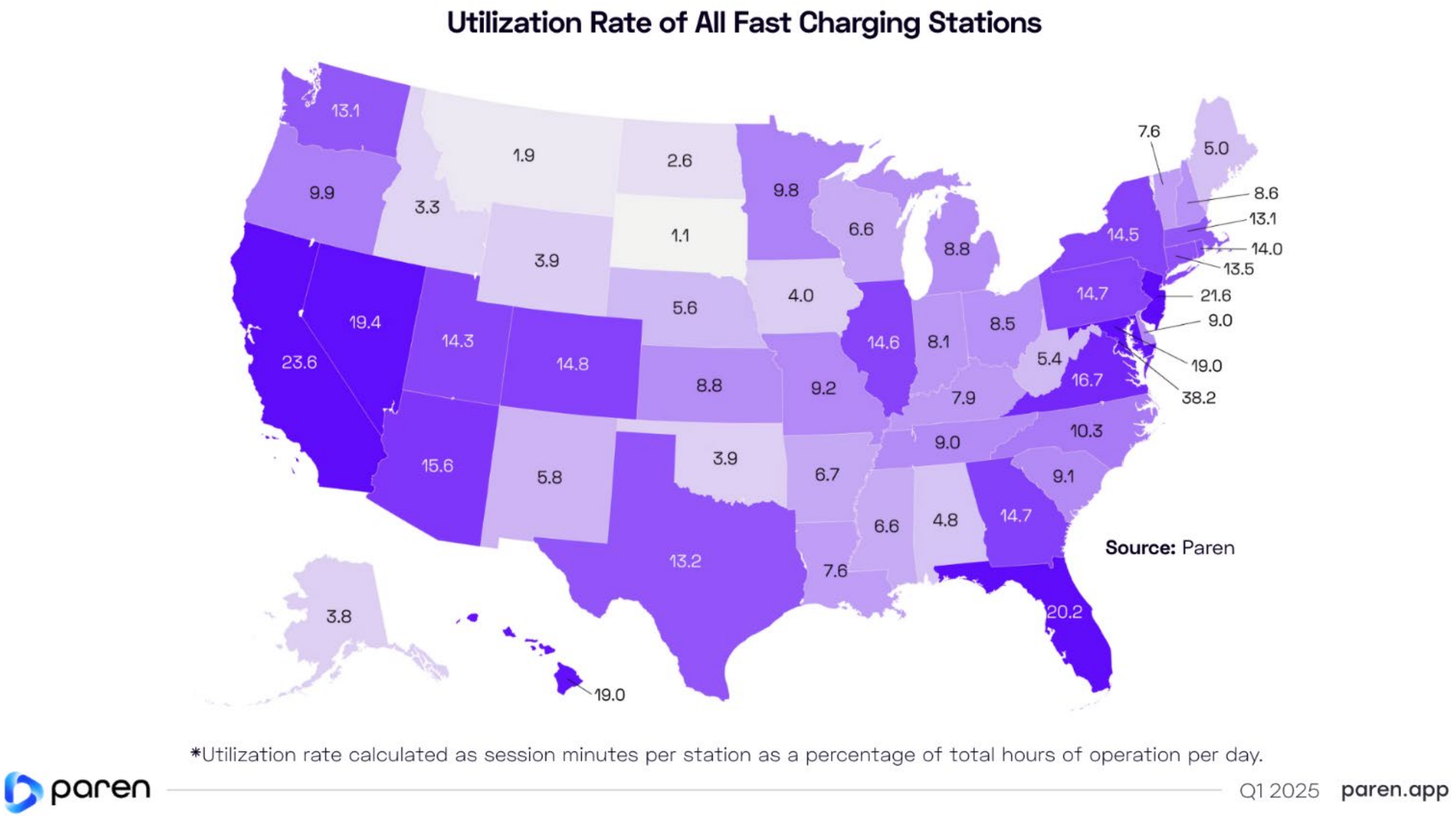
2.3 M

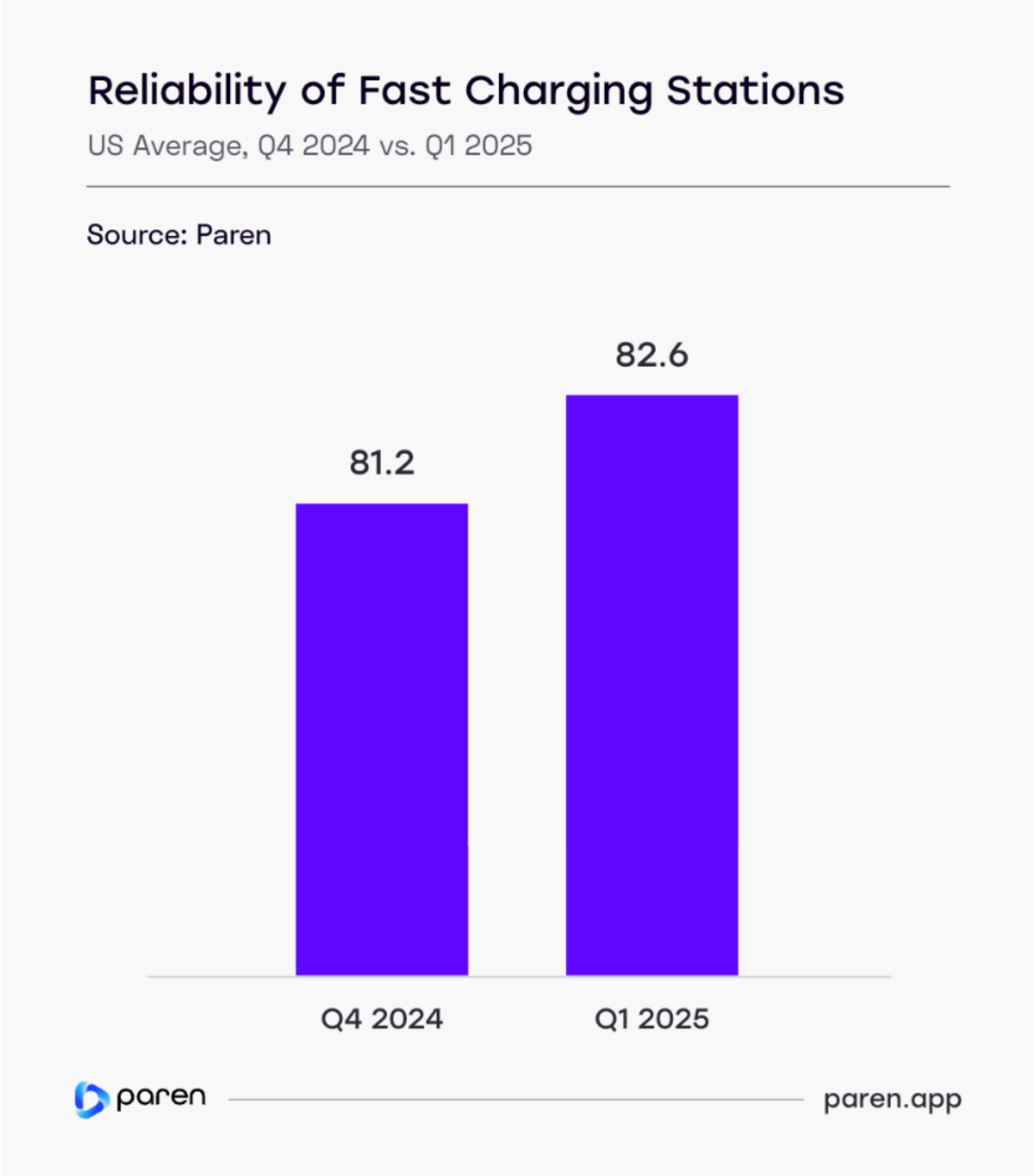
Level 2 charging stations needed by 2030 based on S&P Global forecast of 28.3 million EVs

172,000

DC fast chargers needed by 2030 based on S&P Global forecast of 28.3 million EVs

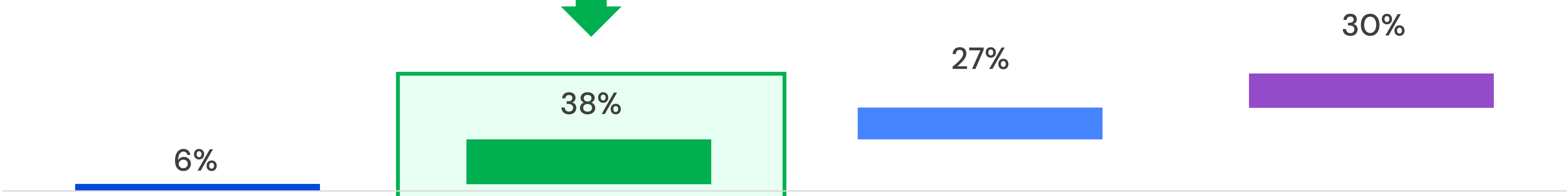
Reliability of public charging is improving, slowly





Source: Paren, "US EV Fast Charging – Q1 2025"

The next tranche of EV adopters will have high(er) expectations



EV Owners

Currently own an EV

Next-wave Adopters

Intend to buy/lease EV as next vehicle if expectations are met

Looking for:

- **Convenient charging** locations: <30 min detour
- **Faster charging:** 20 min sessions

Longer-term Adopters

Have considered, but don't plan to buy/lease EV as next vehicle

Looking for:

- **Publicly accessible charging:** Lower % at-home charging
- **Variety of charging use cases:** To support use of EV as primary vehicle

EV Hold-outs

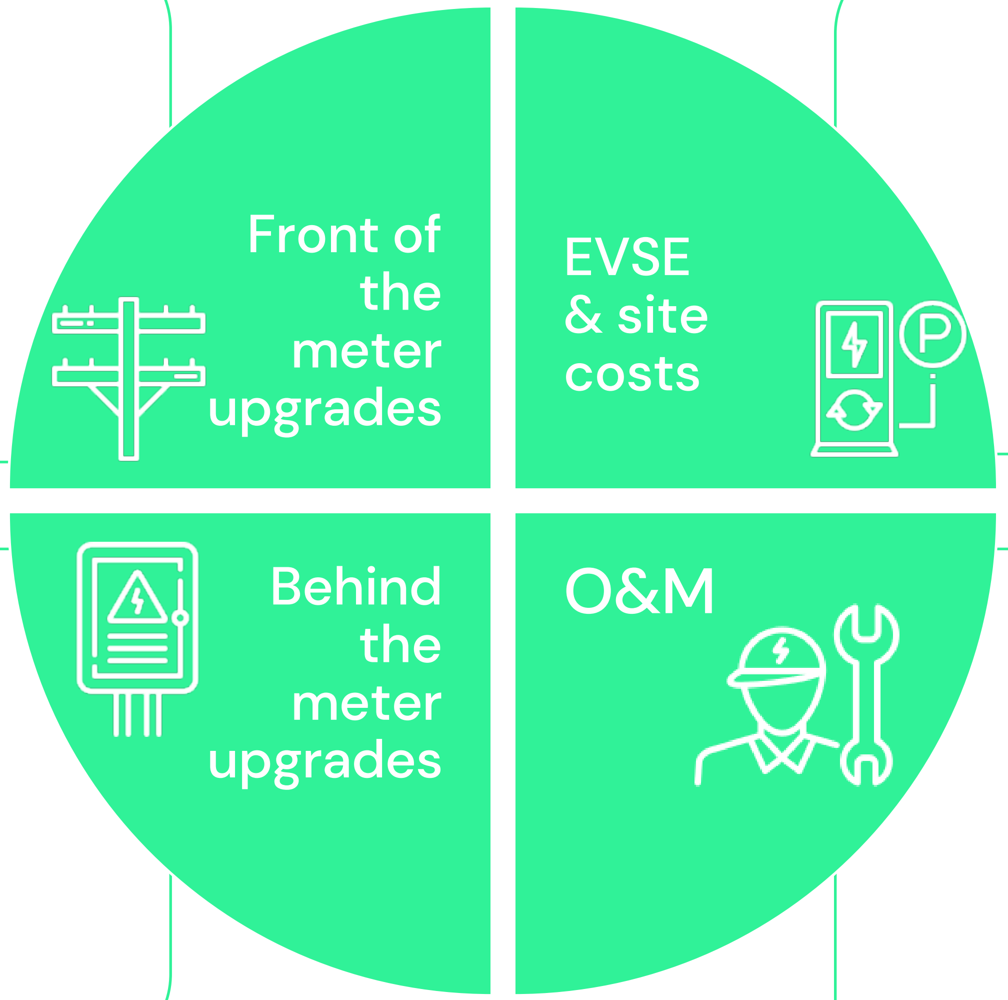
Have not considered and do not intend to buy/lease EV

Source: BCG "Can OEMs catch the next wave of EV adopters?";

n= 3,000; Because of rounding, values do not total 100

Infrastructure is expensive and often complicated

- Step down transformers
- Line extensions
- New point of entry at the property or service drop
- Meter upgrades
- Panel upgrades



- Charger
- Bollards / protective equipment
- Signage
- Lighting
- Paving / painting
- Accessibility / ADA compliance

- Step up transformers
- Meter upgrades
- Panel upgrades

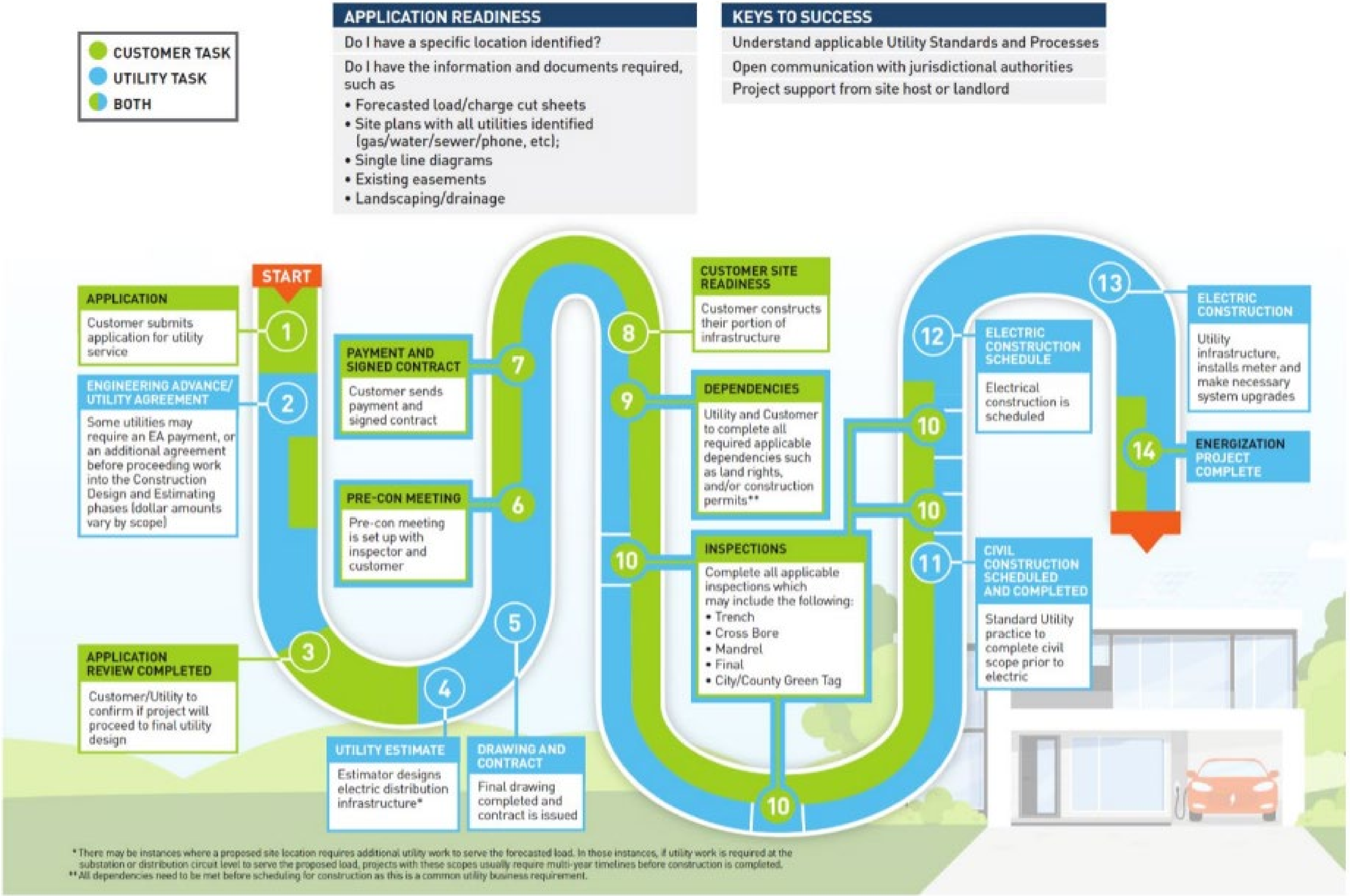
- Networking fees
- WiFi/Cell service
- Service agreements
- Equipment replacement
- Site upkeep and routine operations
- Electricity costs including demand charges

Note: needs vary significantly between sites

The interconnection process can lack urgency and transparency

Potentially exacerbated by:

- More EVs
- Greater charging power levels
- Fewer “ready” sites
- Potential for integrating batteries, etc.
- Competing utility demands and priorities



Source: PG&E/CA Joint IOUs, via Alliance for Transportation Electrification

Energy demand is on track to skyrocket…

U.S.-wide electricity demand and summer peak demand projections relative to 2024

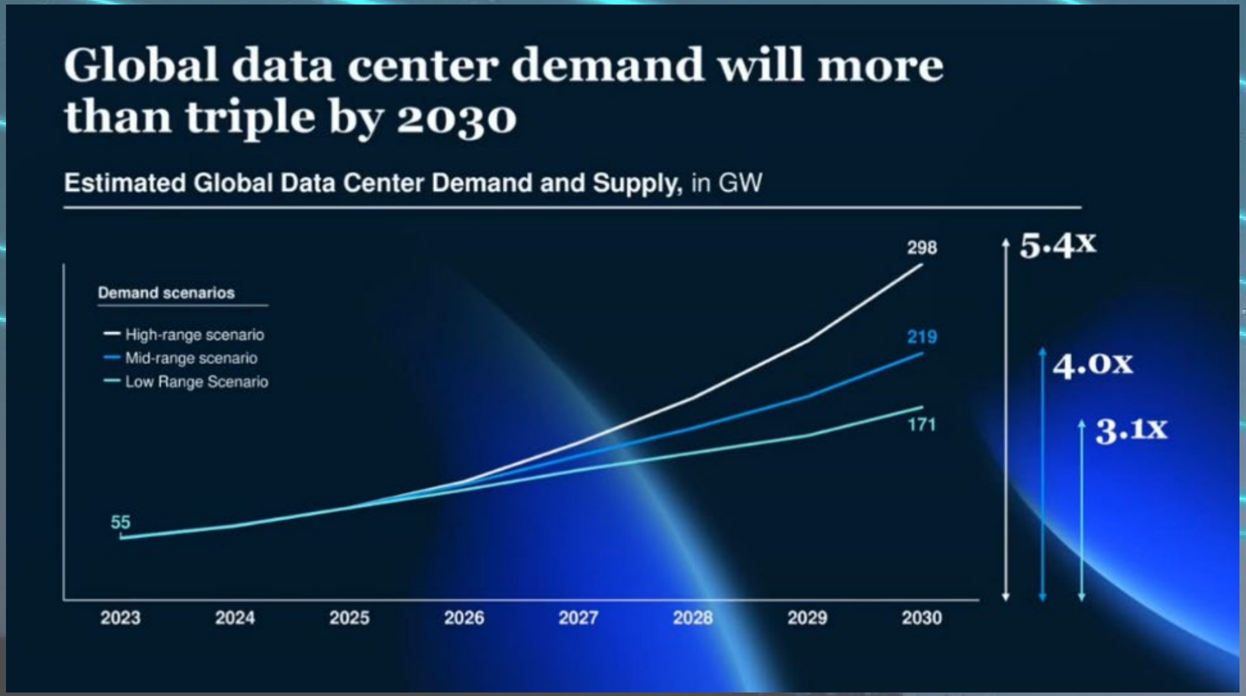
9%
increase in electricity demand by 2028

5%
increase in peak demand by 2028

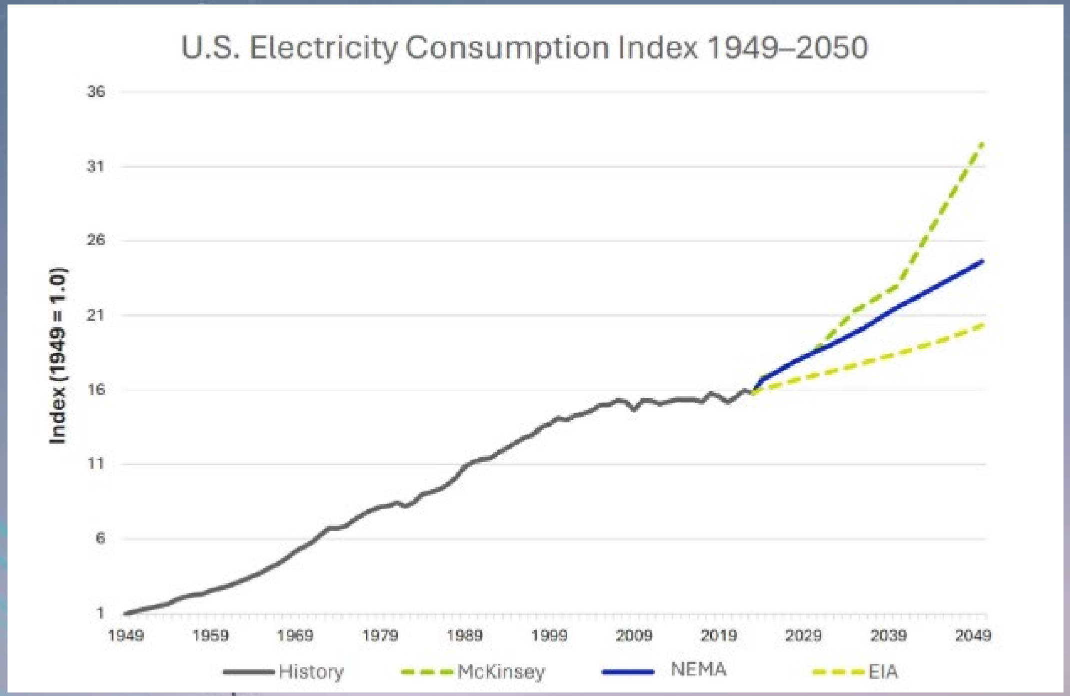
18%
increase in electricity demand by 2033

11%
increase in peak demand by 2033

Source: ICF

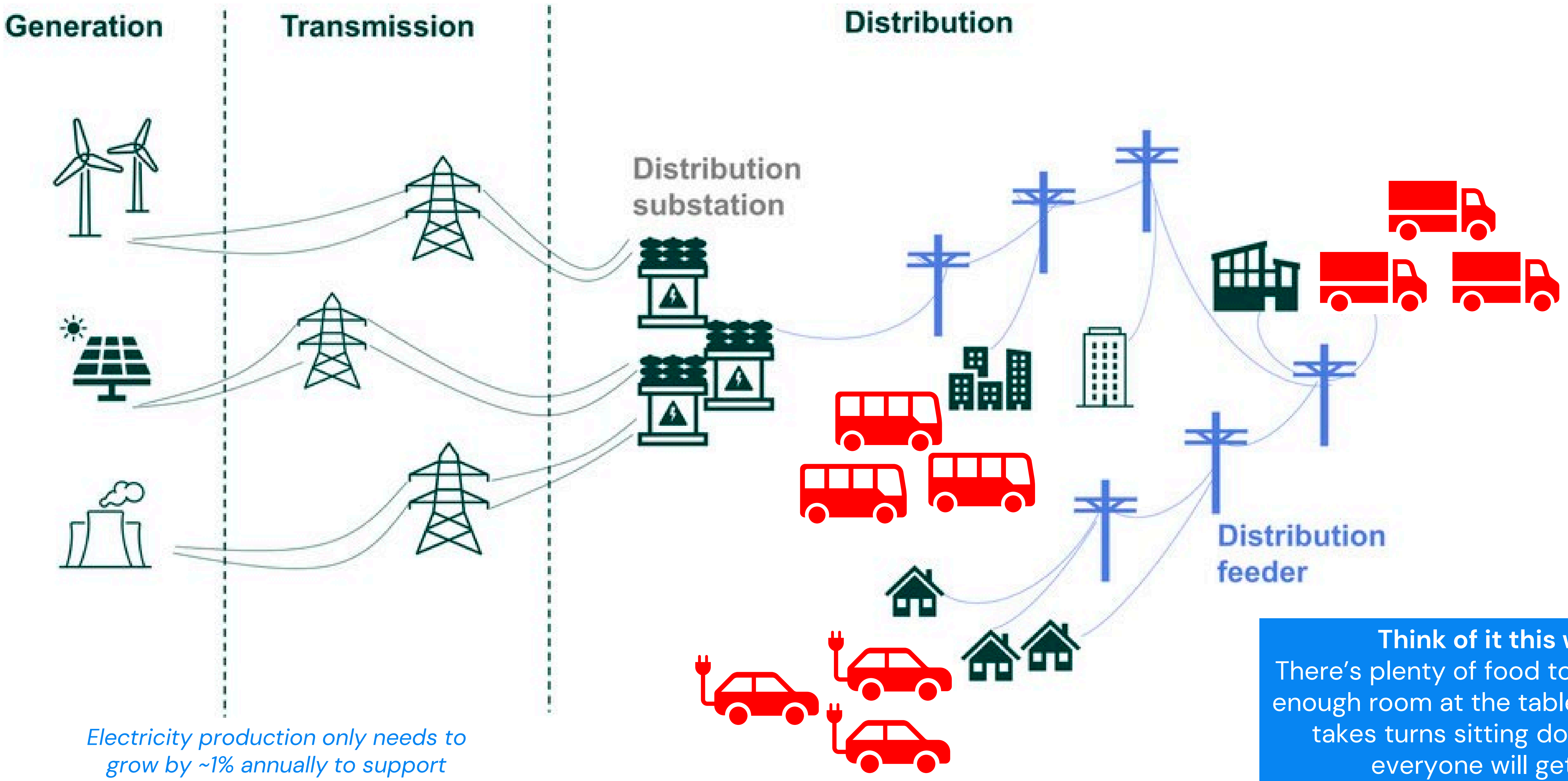


Source: McKinsey



Source: NEMA

…therefore grid readiness is perceived to be questionable



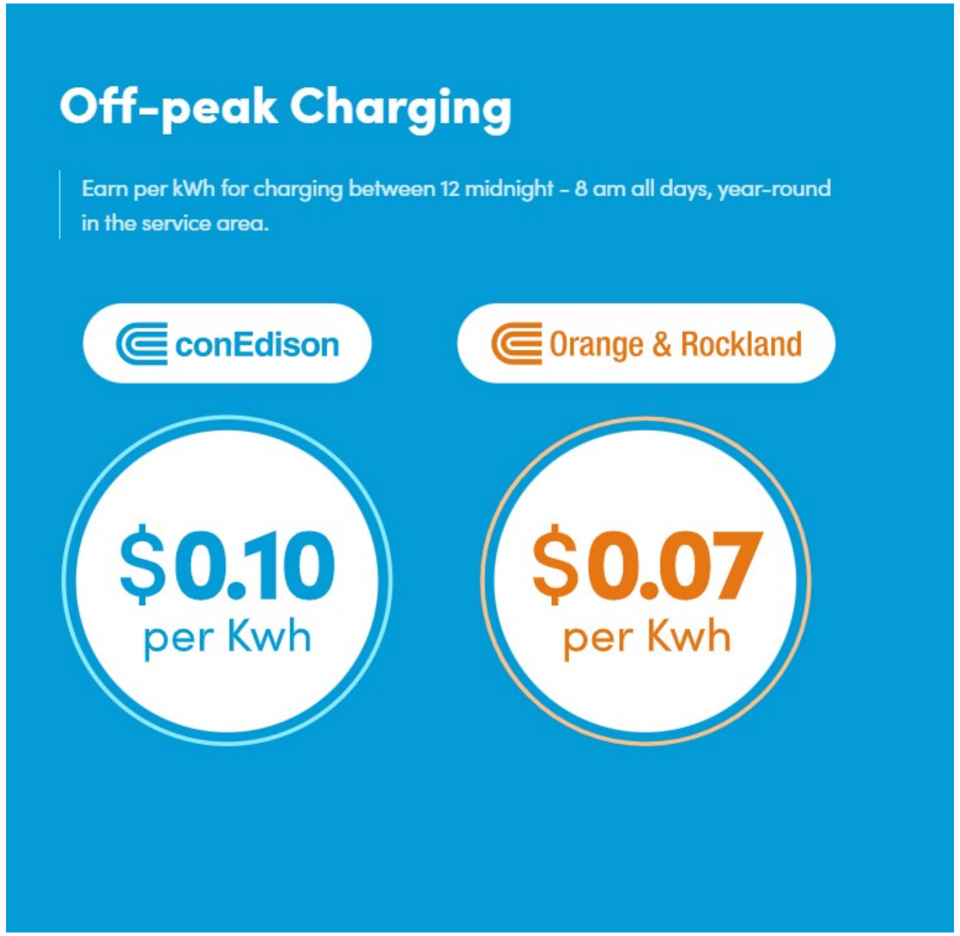
Electricity production only needs to grow by ~1% annually to support passenger EV adoption through 2050

Think of it this way:
There's plenty of food to eat, just not enough room at the table. If everyone takes turns sitting down to eat, everyone will get fed.

Opportunities

Effective load management can provide value to the grid & users

Approach	Less Complex	→	More Complex
Passive	Behavioral load control	Off-peak charging incentives	Time-varying rates
	Behavioral EV demand response	EV critical peak rebate	EV-TOU rate, EV critical peak pricing
Active	Event-based direct load control	Continuous direct load control	Bi-directional charging
	EV demand response	Flexible load management	V2H, V2B, V2G
Emerging		technology-based incentives	



Source: Con Edison and Orange & Rockland Smart Charge NY

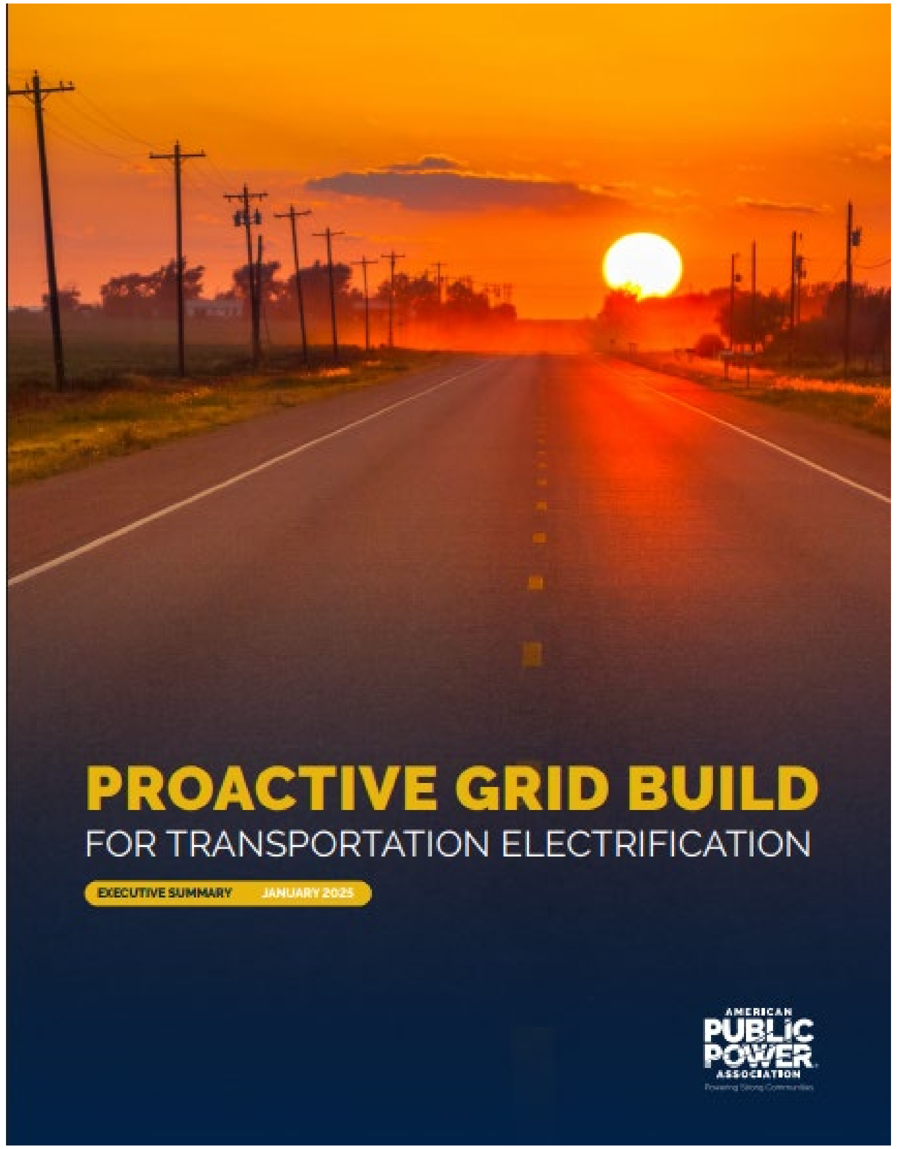
Grid modernization is making a proactive shift

Approaches:

- Integrated Distribution System Planning (IDSP)
- Interregional Transmission Planning
- Grid-enhancing technologies
- Virtual power plans (VPPs)

Examples:

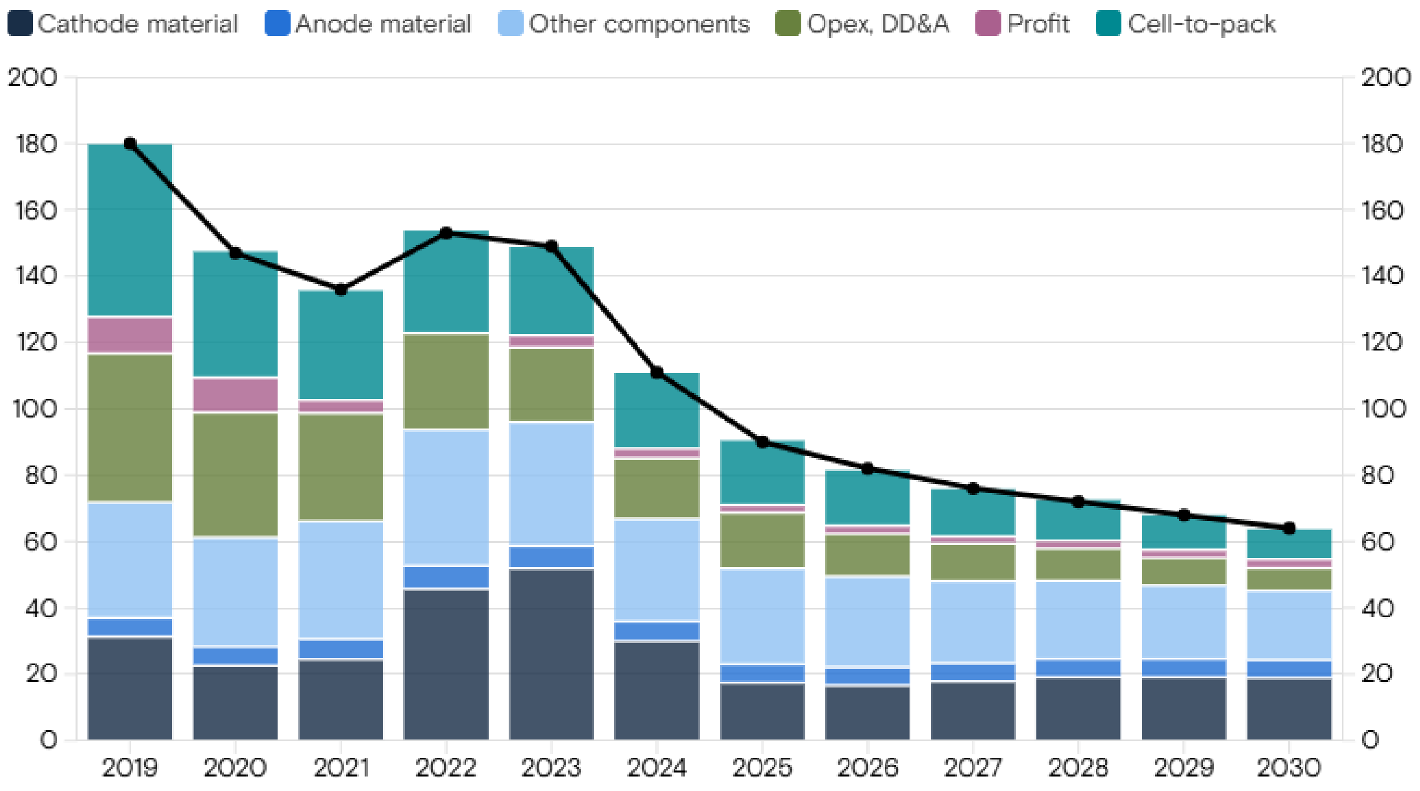
- CA Public Utilities Commission – Proactive Planning Framework for Transportation Electrification
- NY Department of Public Service – Proactive Planning for Upgraded Electric Grid Infrastructure
- MD DRIVE Act
- VA HB 2346



Batteries hold the key

Battery prices forecast to continue to fall

Global: average battery pack prices (US$/kWh)



Source: Company data, Wood Mackenzie, SNE Research, Goldman Sachs Research
2024- 2030 are forecasts

Goldman Sachs

Source: EEI

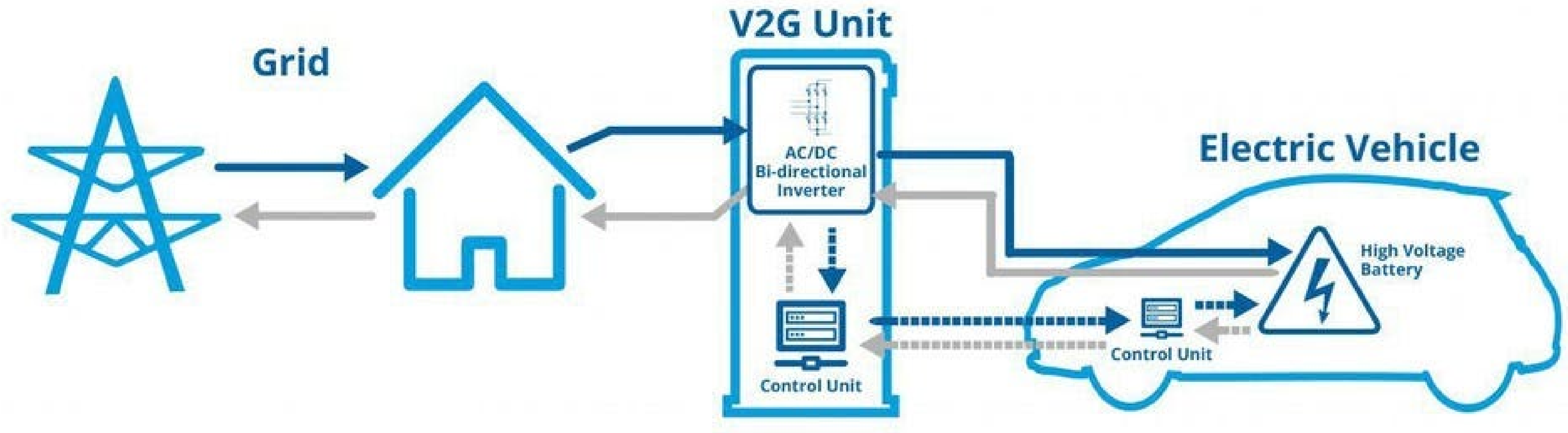
Source: AlphaStruxure and Montgomery County

Vehicle-grid-integration (VGI) is becoming a universal goal

Power sector problem:
Need storage for intermittency, frequency regulation, resiliency, etc.

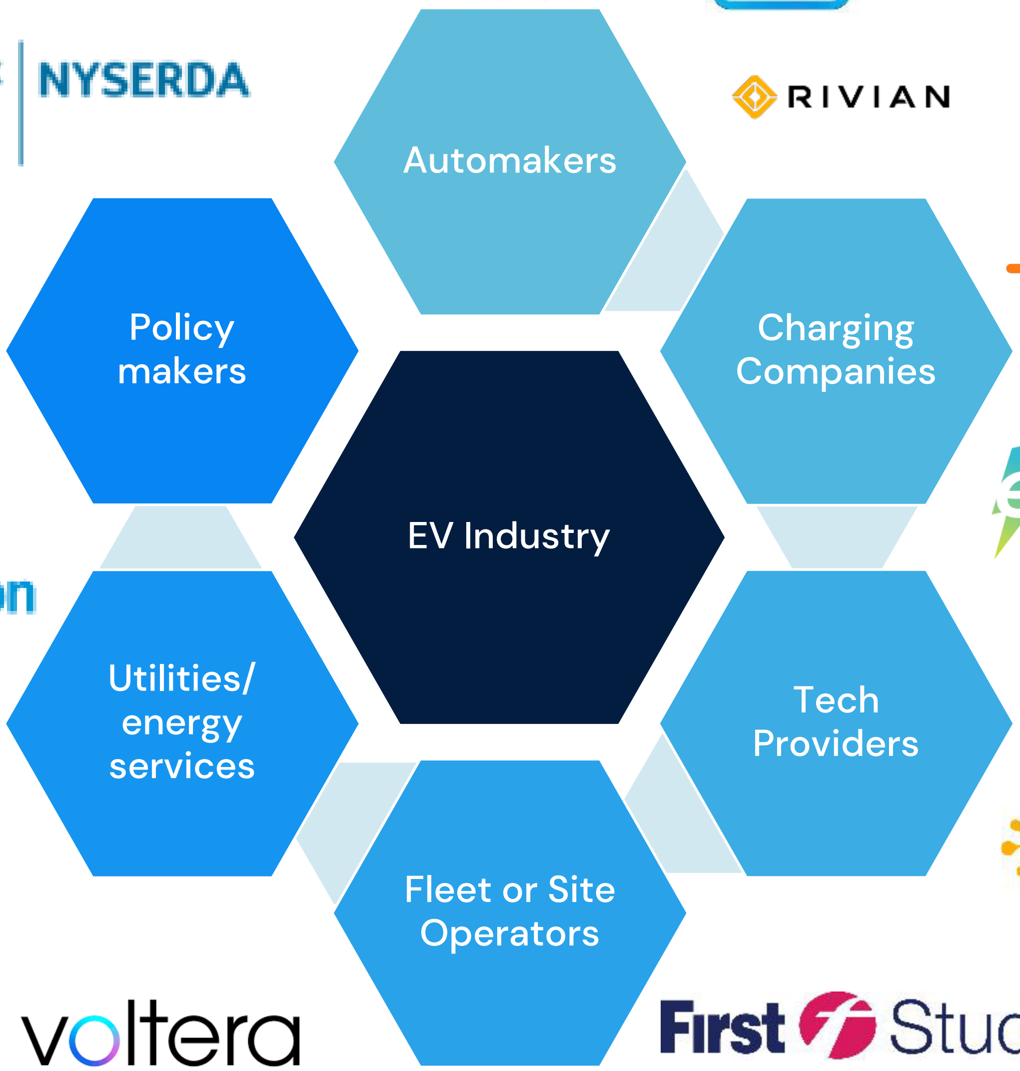
VGI can help stabilize the grid and integrate renewables, while reducing the total cost of ownership the vehicle battery and for the EV owner

EV industry opportunity:
Abundance of unutilized storage in EVs, a flexible and mobile load.



Source: FleetCarma/Geotab

A diverse ecosystem = increased opportunities to engage



More resources exist today than ever before

- National trade groups
- Alternative Fuels Data Center
- Joint Office of Energy & Transportation (e.g., BESS help sheet)
- State agencies (energy, transportation, public service)
- Fleet associations
- Utilities
- Local governments
- Clean Cities coalitions
- EV user/peer groups
- Equipment/service providers

Q&A
Conclusions

ICF's TE Thought Leadership

- ICF Service Areas & Insights include:
  - Clean Vehicles and Alternative Fuel Solutions Consulting
  - Electrification Solutions
  - Fleet Electrification Advisory and Consulting
  - Hydrogen Energy Insights
- Forbes column: https://www.forbes.com/sites/stacynoblet/
- ICF Climate Center: https://www.icf.com/climate

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