

# Medium and Heavy Duty Zero Emissions Vehicle Supply Chain Analysis

June 2021



# Findings

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- The transition to medium and heavy duty zero emissions vehicles (MHD ZEV) like trucks and buses is a major opportunity for the U.S. economy - many companies and states are already taking advantage
- Billions in new economic activity and hundreds of thousands of jobs are already directly connected to this transition – indirect activity and job growth is much higher

# Findings

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- At least 44 states and Wash. DC have companies involved in the zero emissions truck and bus market, at least 22 states have greater than \$100 million in announced corporate investments
- Domestic manufacturing of vehicle components is by far the largest driver of investment in MHD ZEV supply chain

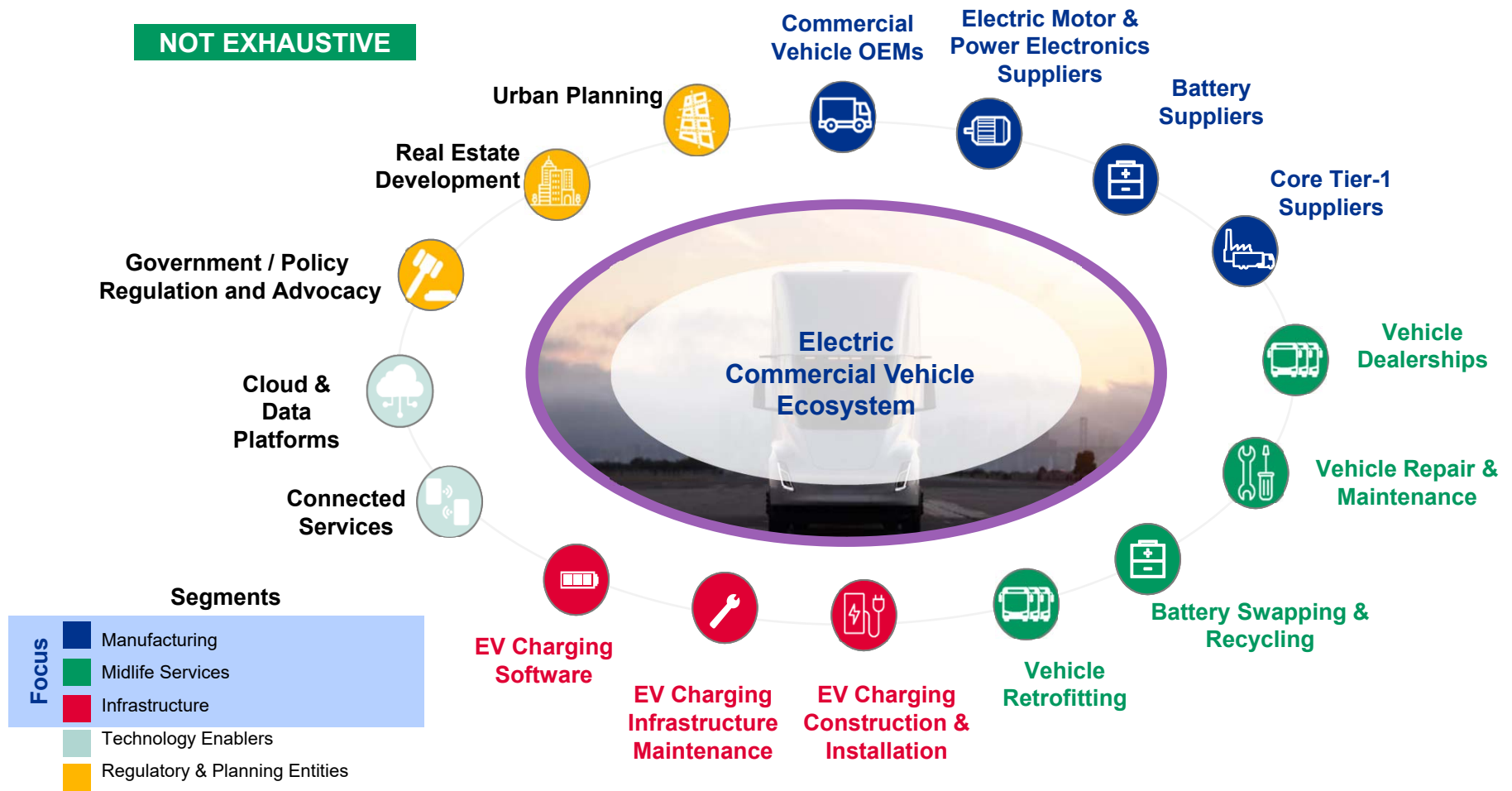
# Disclaimer

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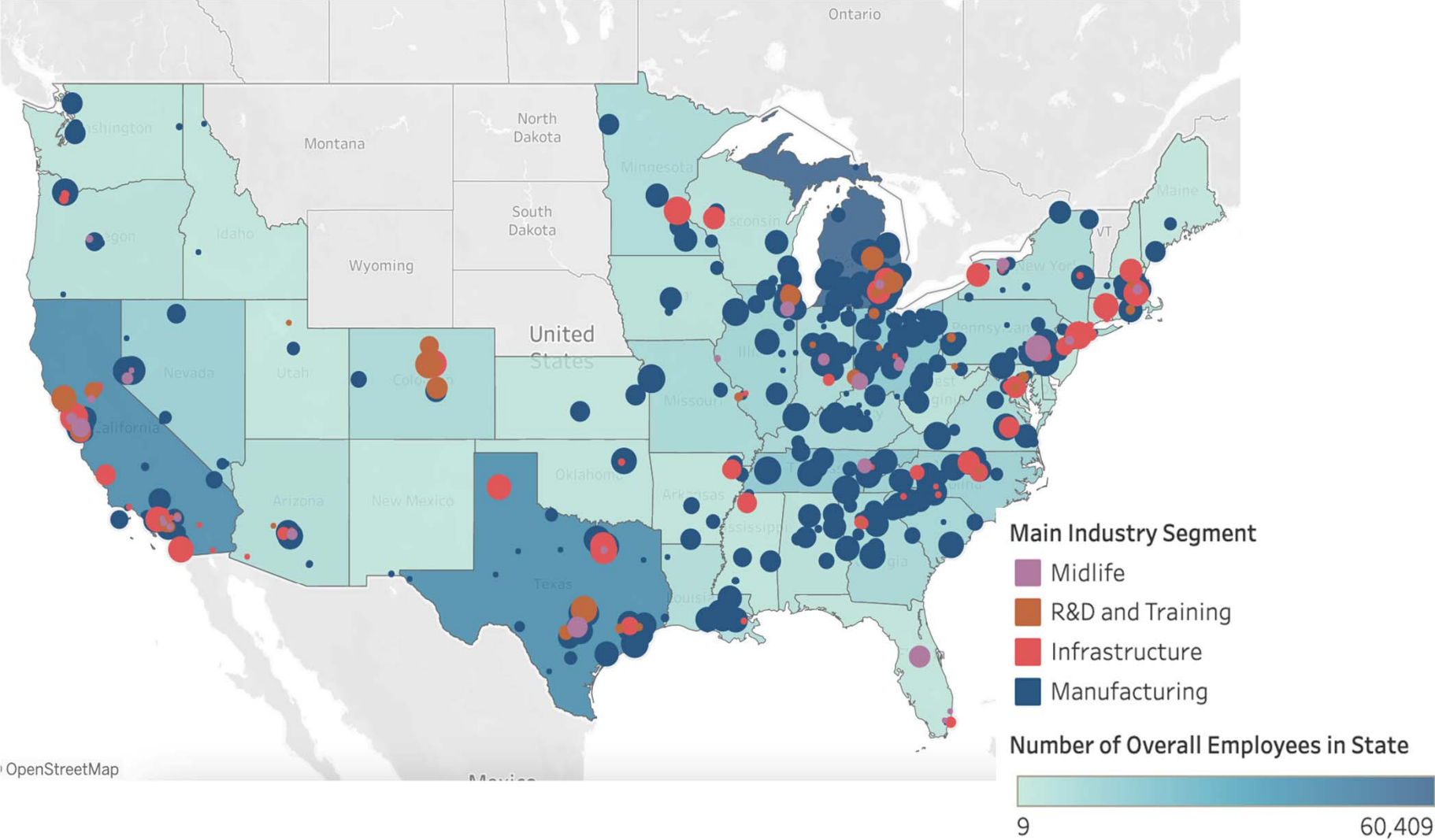
The material included in this analysis is meant to capture the current state of the MHD ZEV supply chain in the United States and is not an endorsement of any particular project or company. Any project or company involved in this sector must comply with state and federal laws, and inclusion of corporate information or recognition in this analysis should not be construed as meeting that standard.

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# The MHD ZEV supply chain includes a wide range of players in a complex and rapidly evolving ecosystem



# Companies Involved in the MHD ZEV Supply Chain Found in 44 states and D.C.



# Segment Definitions



## Manufacturing

- Value chain until final assembly of MHD EV, focused on EV-specific parts



## Infrastructure

- Companies directly engaged in installation, construction, and upgrade/maintenance of MHD EV charging stations (level 2 chargers and higher), as well as software companies supporting charging



## Midlife

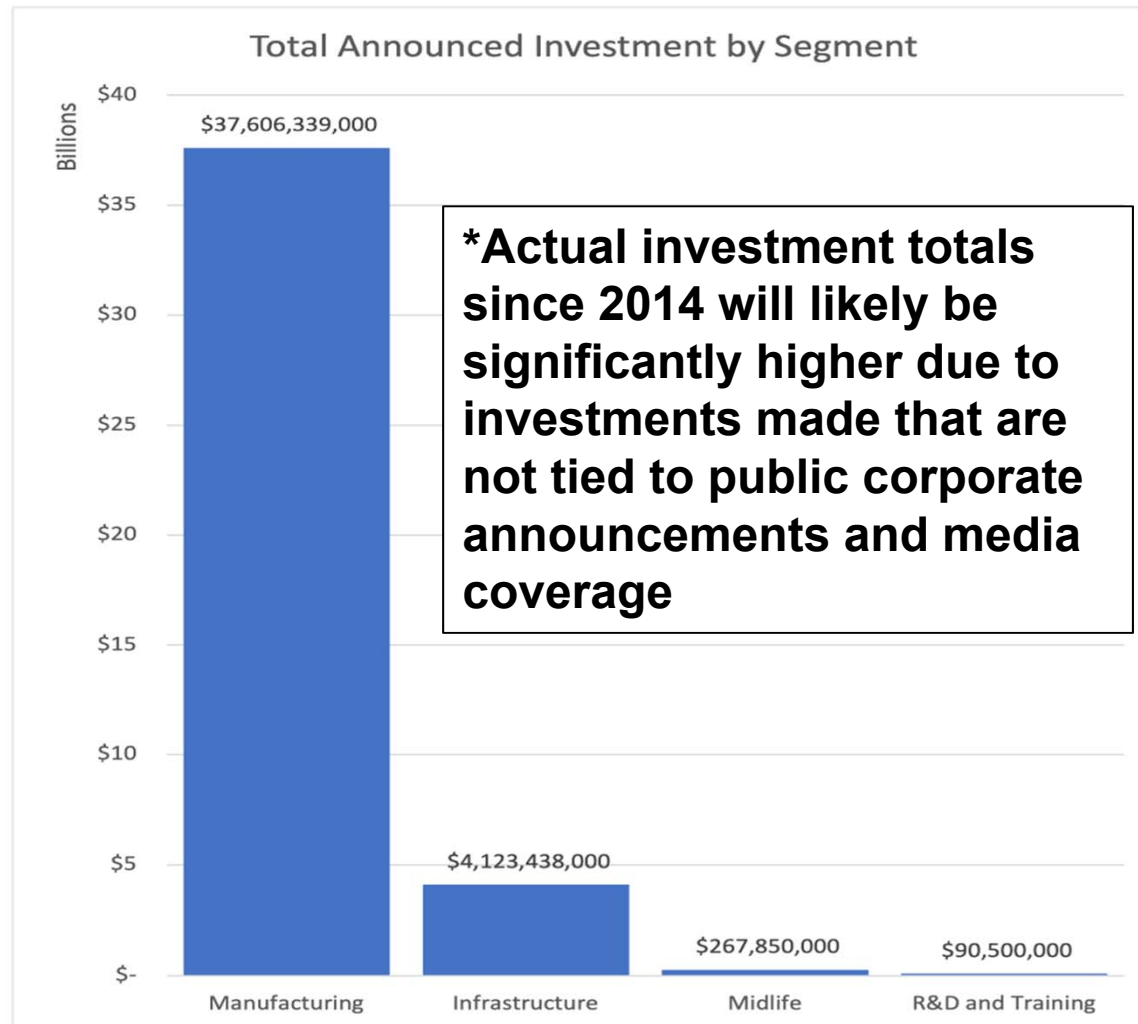
- Companies engaged in maintenance, retrofitting, resale, and battery recycling of MHD EVs



## R&D and Training

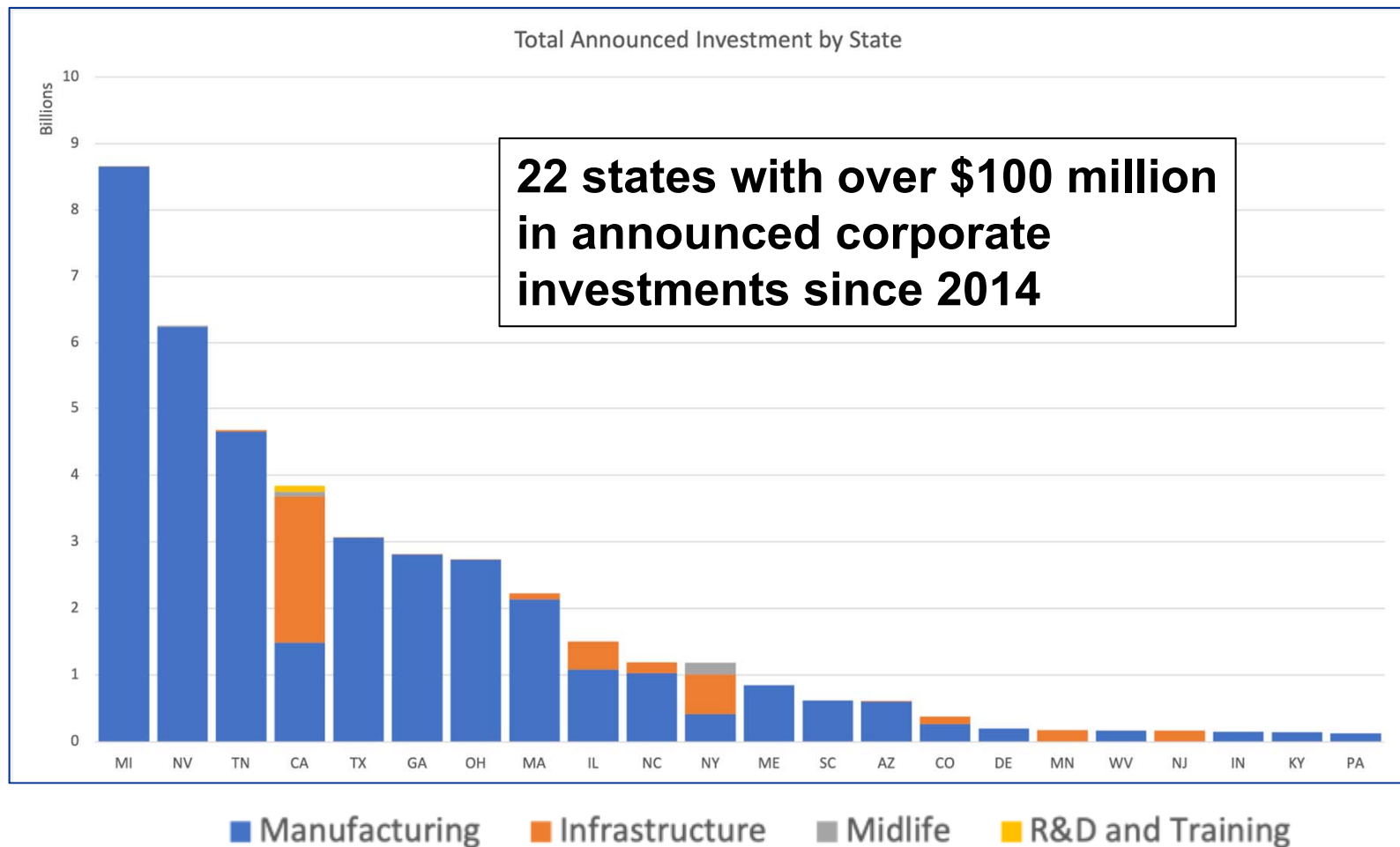
- Companies engaged in EV testing and EV platform design; institutions providing EV trainings to dealer workforce

# Analysis identified 375 companies involved in the domestic MHD ZEV supply chain that have announced over \$42 billion in investment\*



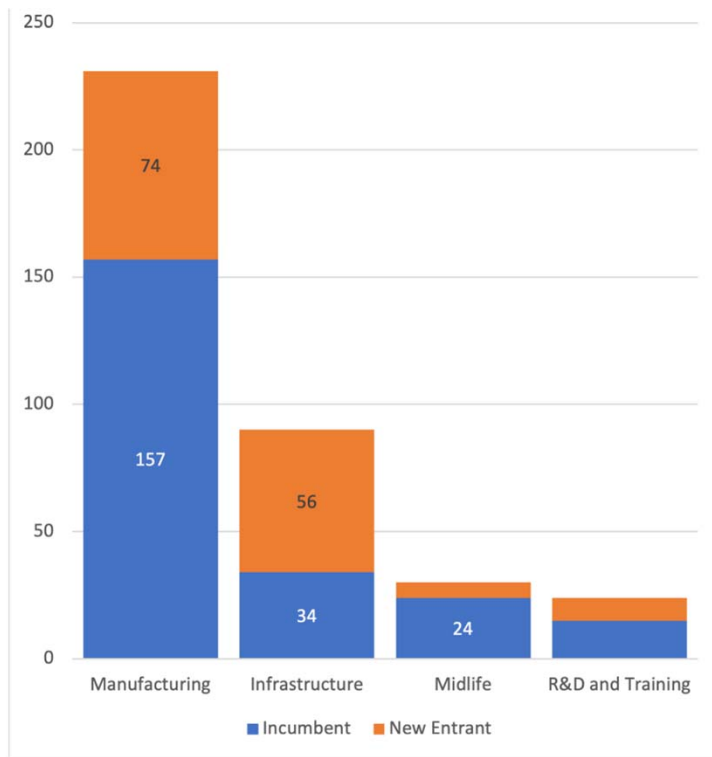


# Analysis identified corporate investments in the MHD ZEV supply chain in significant quantities across the US\*

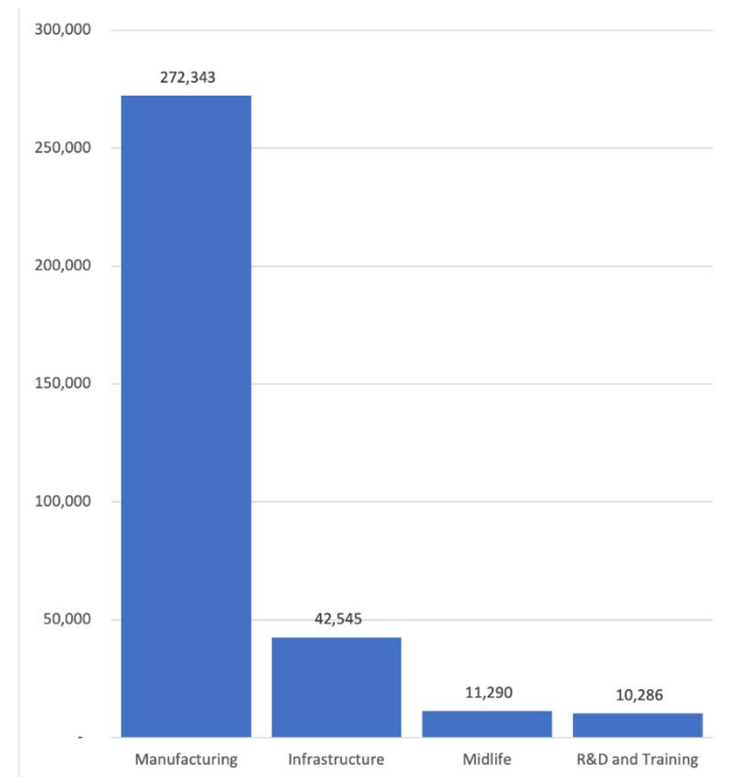


# Analysis identified more than 1,000 locations involved in MHD ZEV supply chain – employing over 336K employees

## Number of companies in each segment

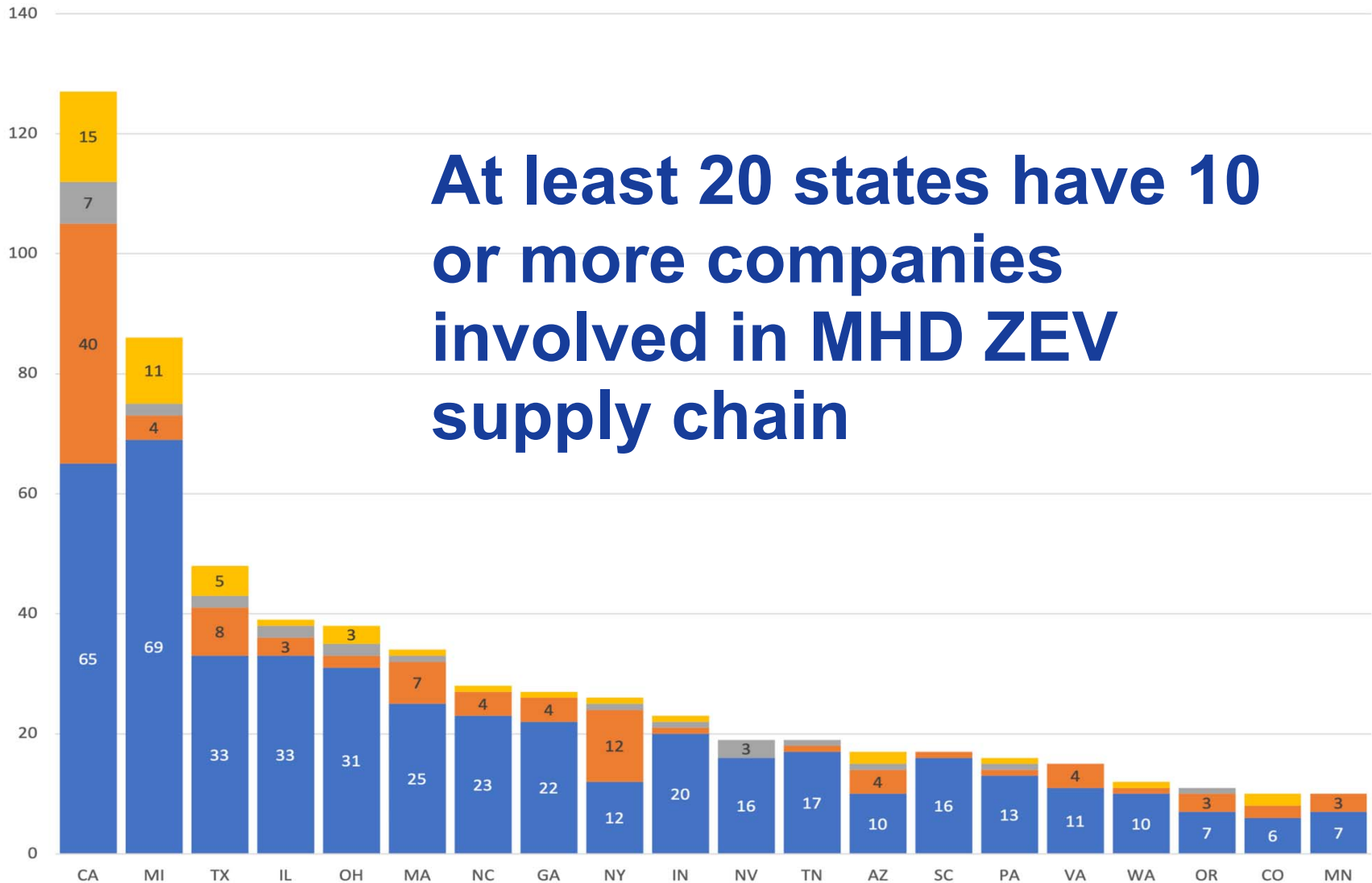


## Employees of companies in each segment



Companies by State

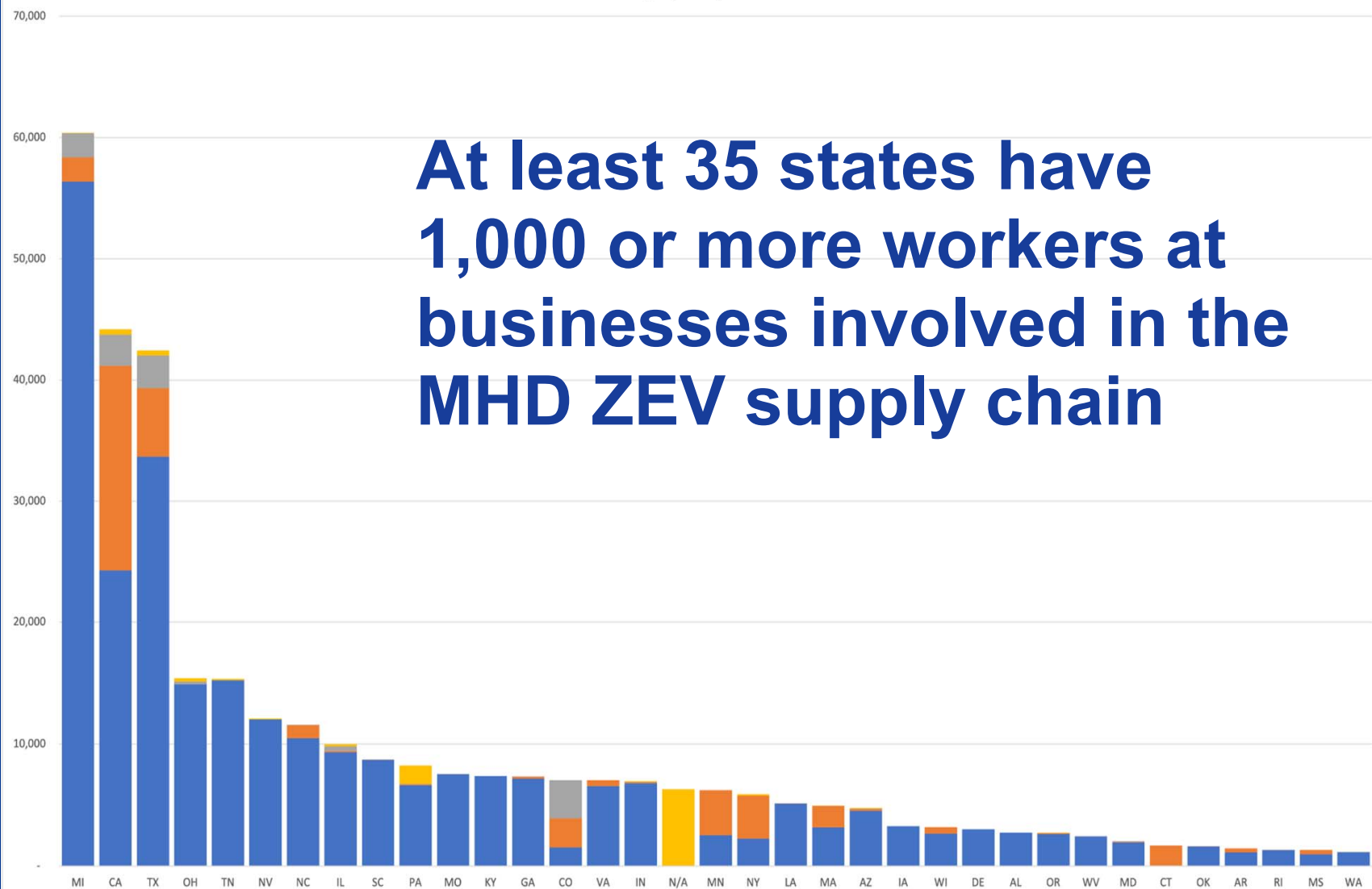
**At least 20 states have 10 or more companies involved in MHD ZEV supply chain**



■ Manufacturing ■ Infrastructure ■ Midlife ■ R&D and Training

Employees by State

**At least 35 states have  
1,000 or more workers at  
businesses involved in the  
MHD ZEV supply chain**



■ Manufacturing ■ Infrastructure ■ Midlife ■ R&D and Training

# **Vehicle and Component Manufacturing**

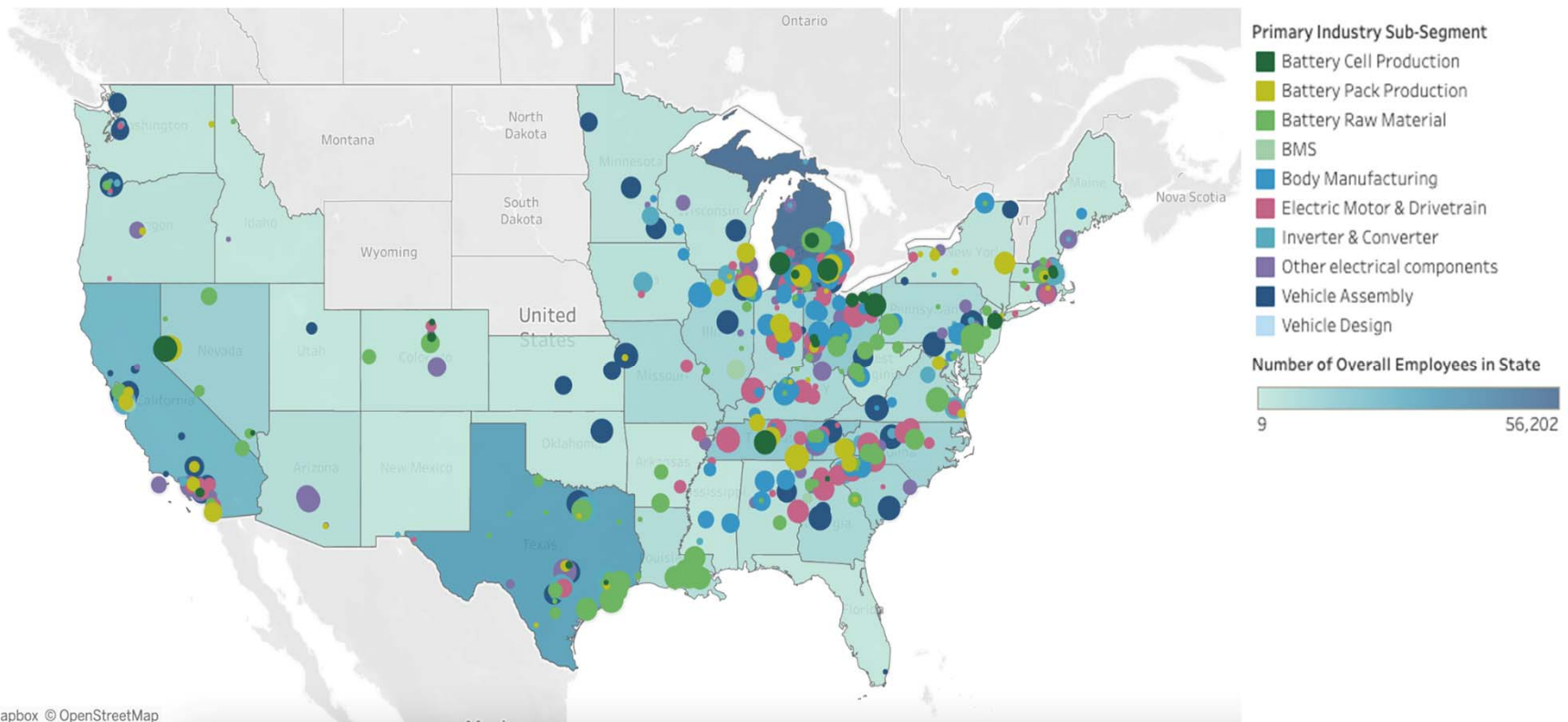
# The key elements of MHD ZEV manufacturing are components of the battery pack, electric motor and other electrical parts



Sub-Segment	Description
1 <b>Battery Packs</b>	Battery pack through sorting of cells, assembly of modules and pack and BMS integration
2 <b>Battery Raw Materials</b>	Base materials for cathodes, anodes and other components and refined metal chemicals
3 <b>Battery Cells</b>	Cells made from manufacturing electrodes, assembling and finishing cells
4 <b>BMS</b>	Battery management system – controls battery and optimizes performance (circuit board, I/O software, control algorithms)
5 <b>Electric motor</b>	Electric traction motor or powertrain (incl. axles) for propulsion as well as regeneration (while breaking)
6 <b>Inverters/Converters</b>	Inverters for DC to AC (for electric motor) and AC to DC for regenerative braking, Converters convert high-voltage DC power to lower voltage for other vehicle systems
7 <b>Other electrical</b>	Controllers (regulating energy and thereby speed), onboard computers, chips, and high voltage harnesses
8 <b>Vehicle Design</b>	Commercial ZEV design
9 <b>Body Manufacturing</b>	Body structures and assemblies (e.g. frames, cab, hood, side rails, cross-members)
10 <b>Vehicle Assembly</b>	Commercial ZEV assembly combining all systems

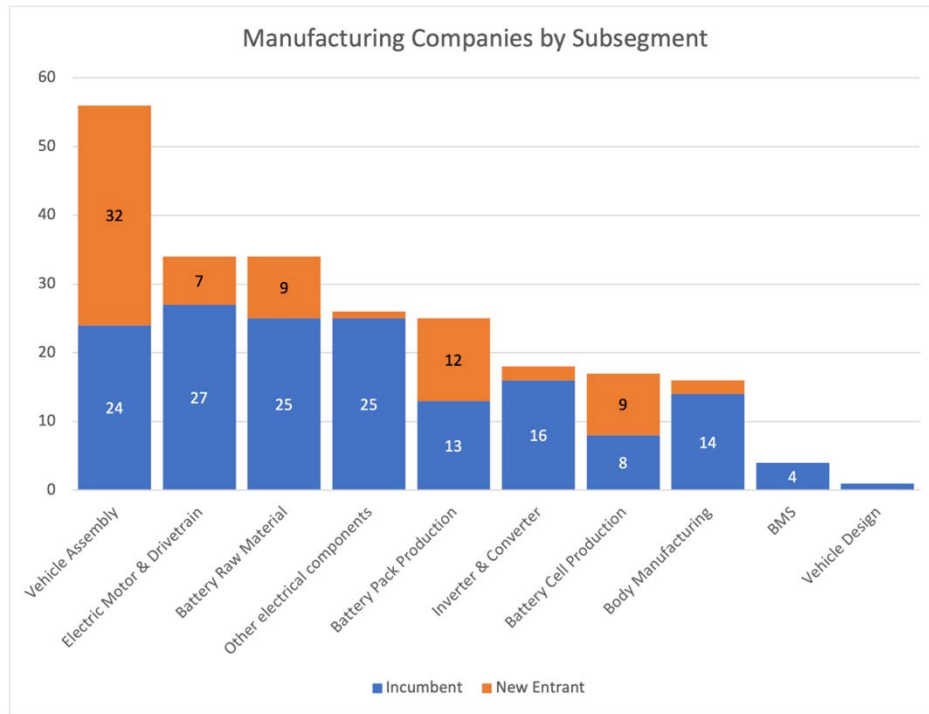
# Most manufacturing employment is currently in CA, TX and MI; the high number in the Midwest is driven by incumbents shifting to EVs

## Manufacturing Employment by State

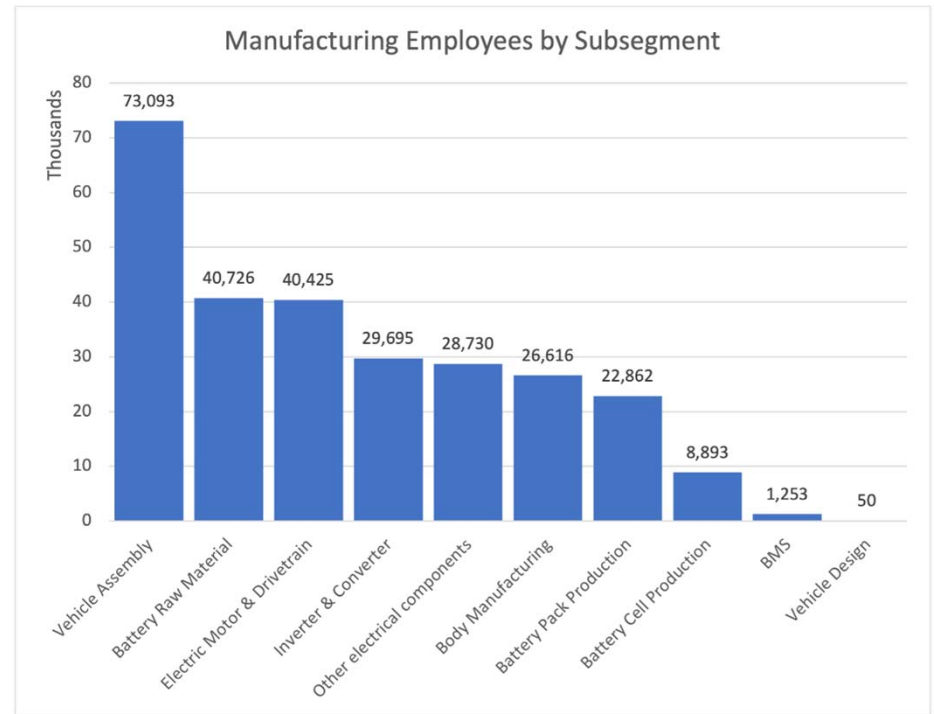


# Most companies and employees are related to vehicle assembly and any activity around the battery

## Number of companies in each sub-segment

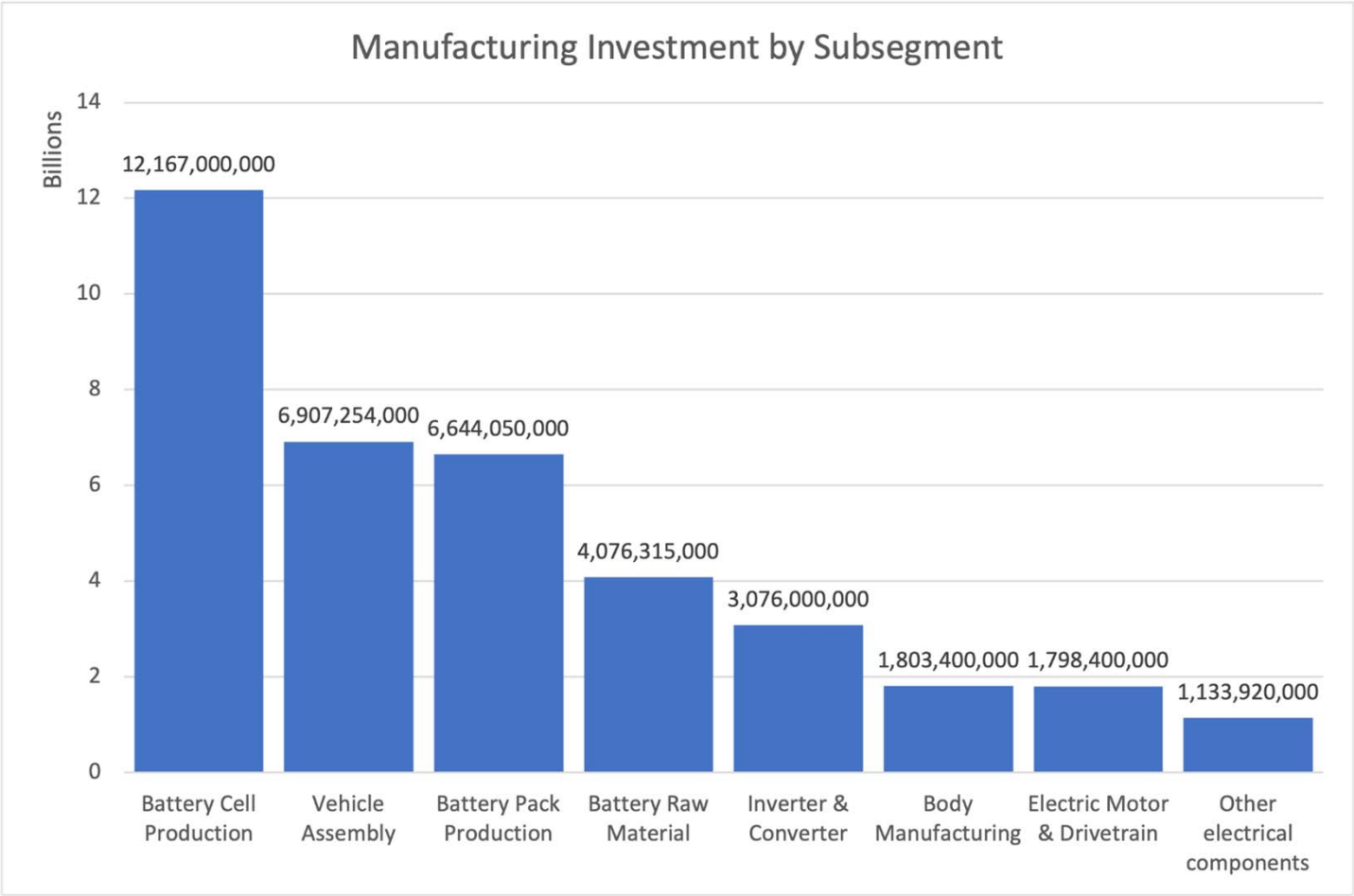


## Employees of companies in each sub-segment





# Most announced investments are in battery cell and pack production, and vehicle assembly

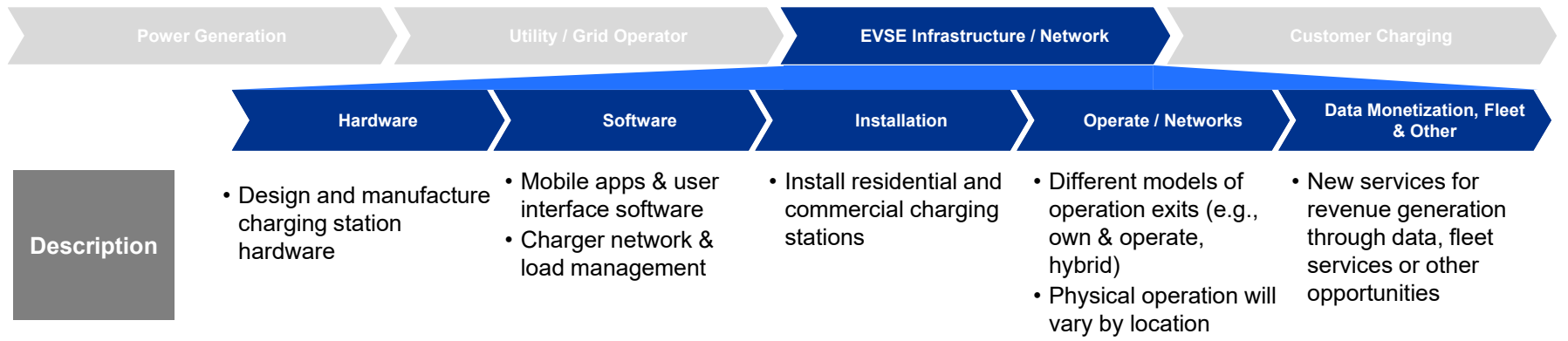


# **Infrastructure\* Manufacturing and Installation**

**\*EVSE / Electric Vehicle Supply Equipment**

# Many players participate in multiple elements of the EVSE value chain

Non exhaustive



Example Competitors

**Hardware & Software**

SIEMENS evconnect blink SemaConnect  
 enel x TESLA ABB -chargepoint+  
 PowerCharge Schneider Electric EVBOX DELTA

**Hardware Focus**  
 BOSCH CLIPPER CREEK Webasto BTCPower

**Software Focus**  
 driivz CHARGELAB greenlots GreenFlux

**Network**  
 blink -chargepoint+ TESLA opconnect SemaConnect  
 Fragmented Regional Installers  
 electrify america

**Installation Network Coordinator**  
 Webasto CHARGELAB ev charge network P&G

**Utilities**  
 DUKE ENERGY PG&E

**Destinations**  
 Marriott Hilton Whole Foods Wegmans

**Commissioning**  
 ABB amazon

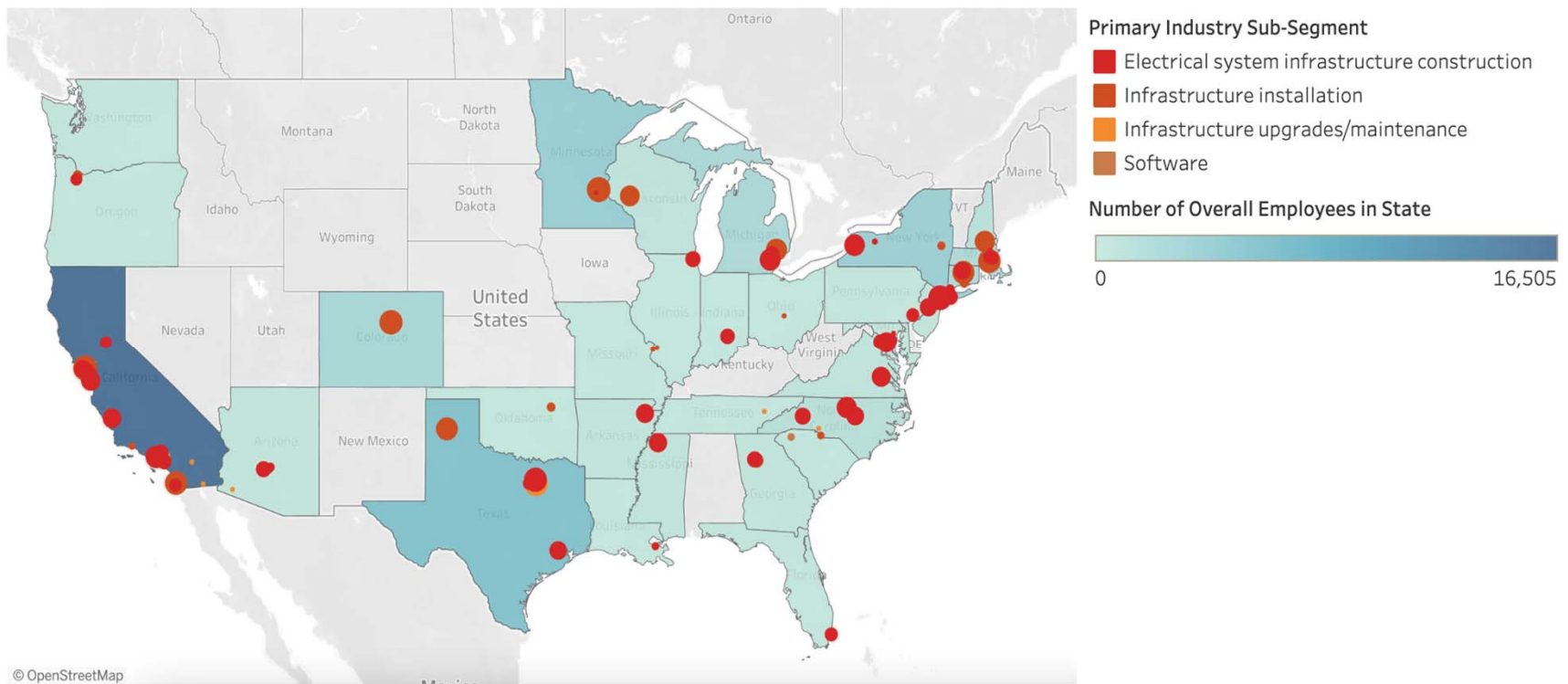
**Airports**  
 SEA LAX Los Angeles World Airport

**Cities / Gov**  
 NYC CHICAGO

enel x greenlots CHARGELAB SIEMENS ABB

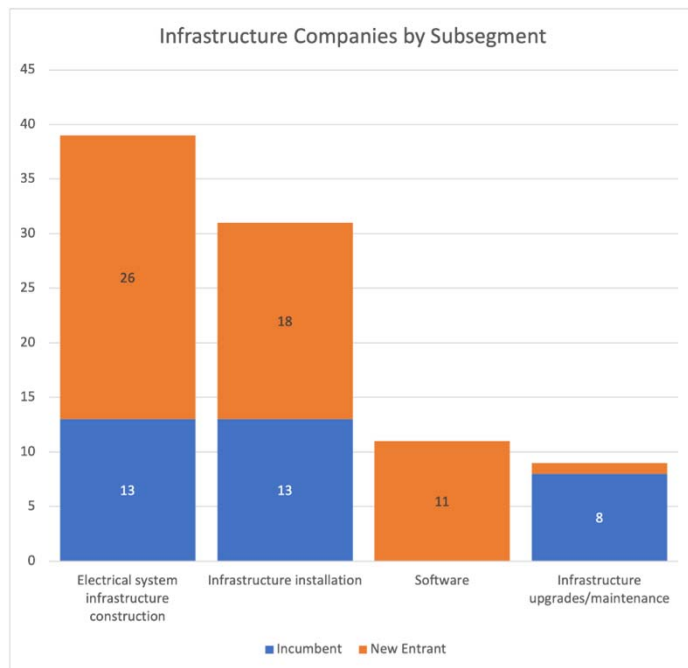
# Most infrastructure employment and companies are currently in CA but also along the East Coast

Infrastructure Employment by State

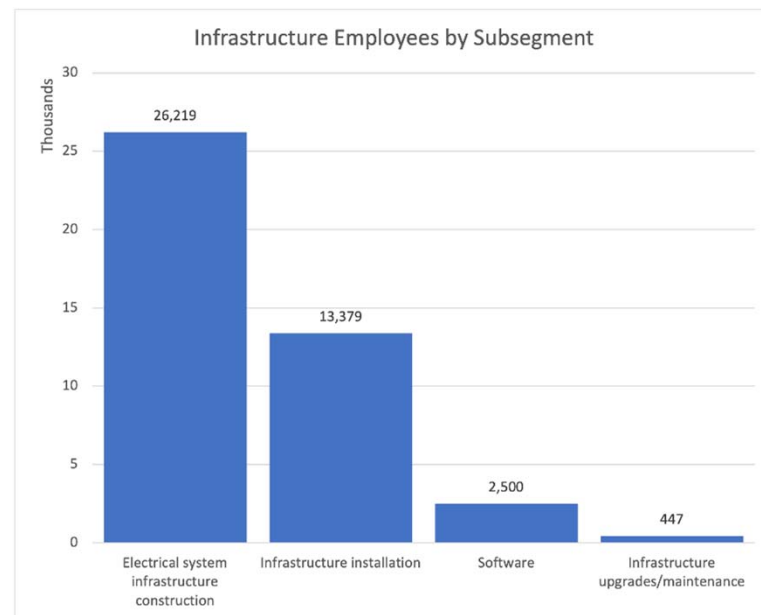


# EVSE manufacturing and installation includes many new entrants and high investments

## Number of companies in each sub-segment

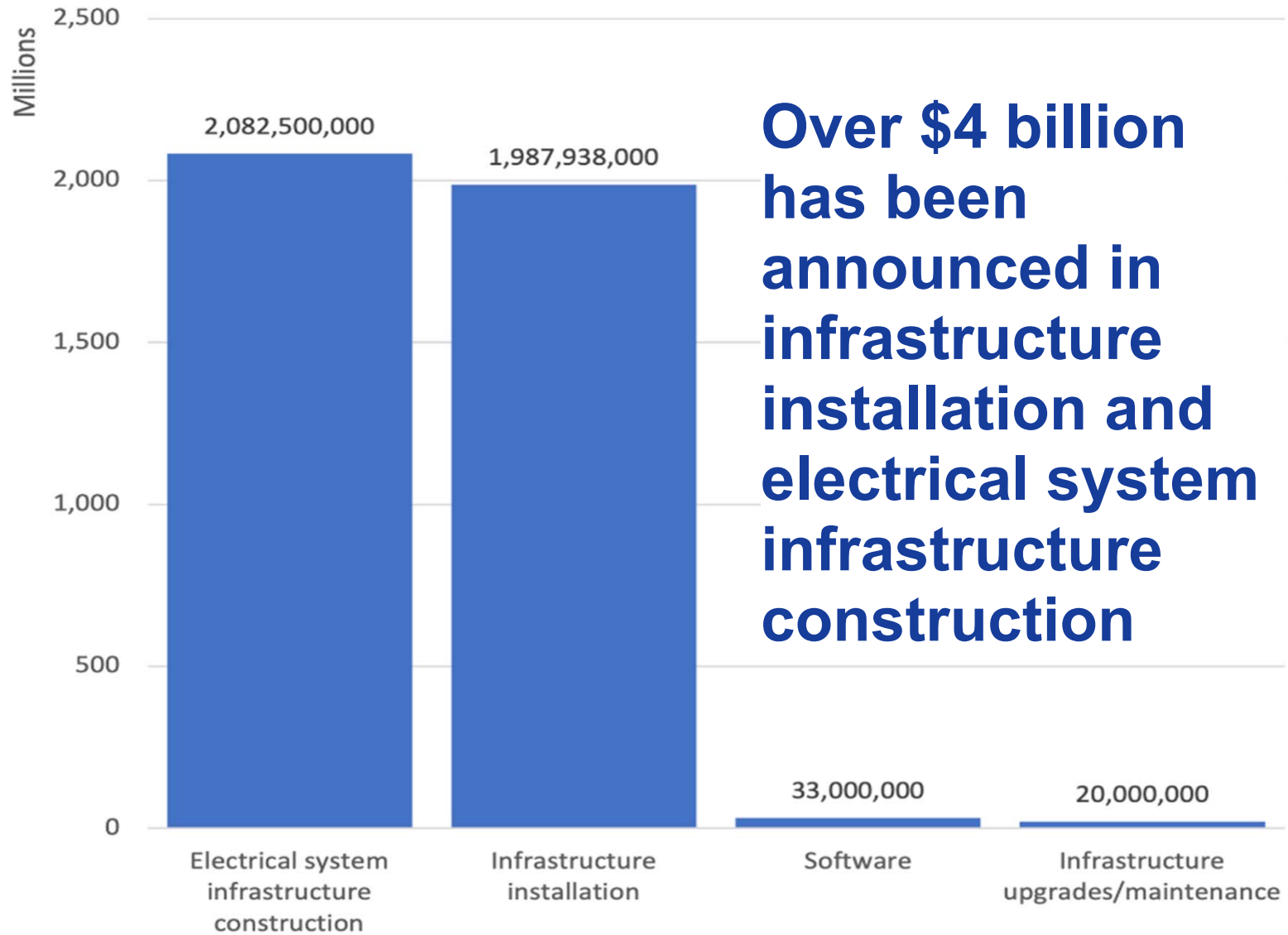


## Employees of companies in each sub-segment



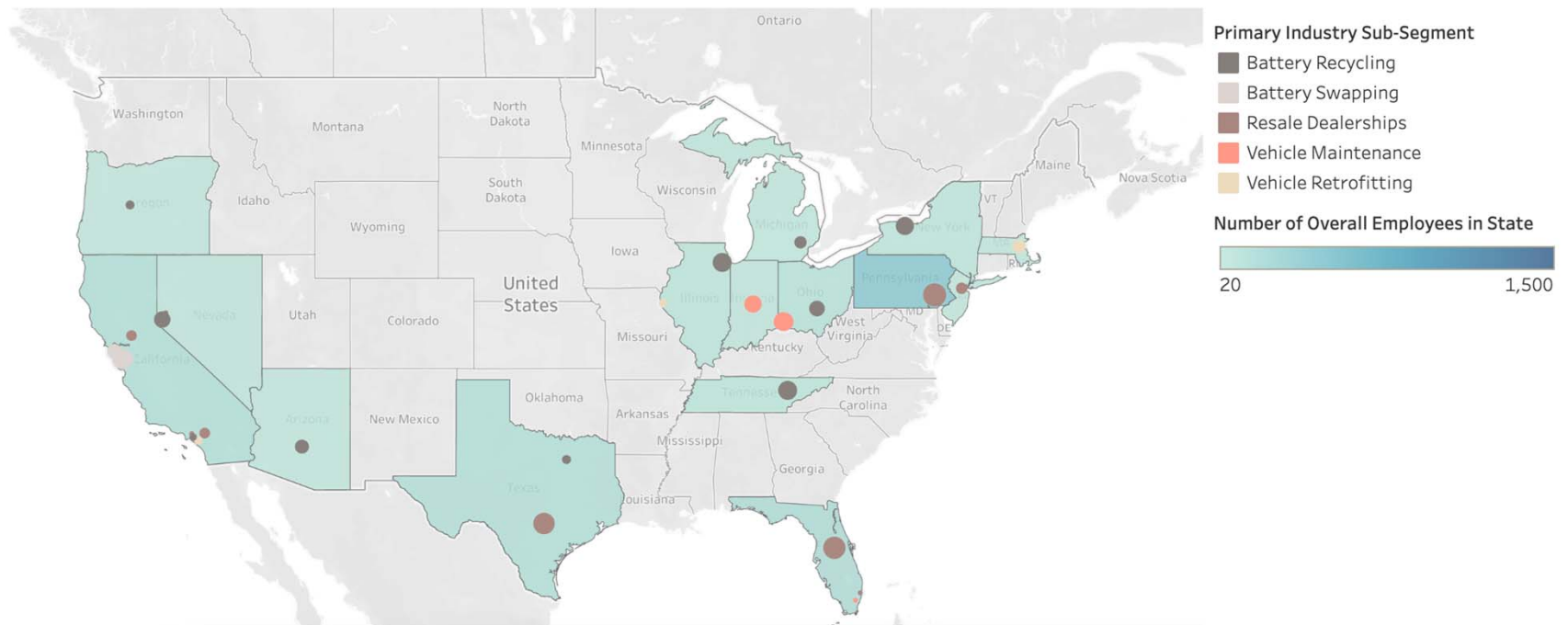
Note: Incumbents from utilities (e.g. PG&E, SDG&E) and electronics (e.g. ABB, Siemens) are main drivers of employment

## Infrastructure Investment by Subsegment



# Midlife

# The few recycling players are located on the West Coast, the Midwest, and Northeast; EV dealers and maintenance facilities will evolve as fleets grow



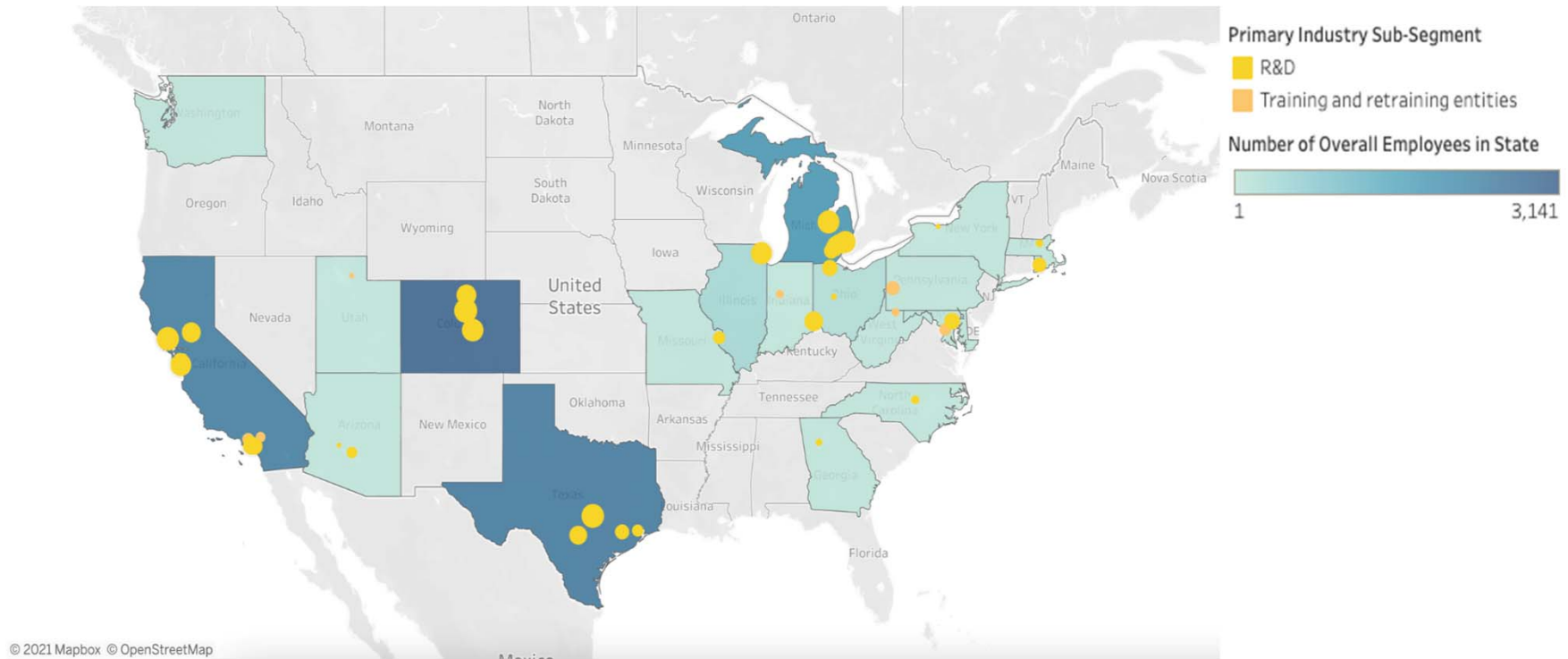
Side note: Battery raw material collection, such as lithium mining, is included in the manufacturing sector analysis. The Biden Administration recently issued a blueprint for environmental protection associated with the extraction of materials critical to the MHD ZEV supply chain which may affect both raw material extraction and recycling.



# **R&D and Training**

# R&D and testing facilities are located in CA, TX, CO and the Midwest; dedicated ZEV training / education is still limited

R&D and Training Employment by State



# Appendix – Scope and Methodology

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# The study focused on ZEV-specific companies in the commercial vehicle supply chain

## Scope and Methodology

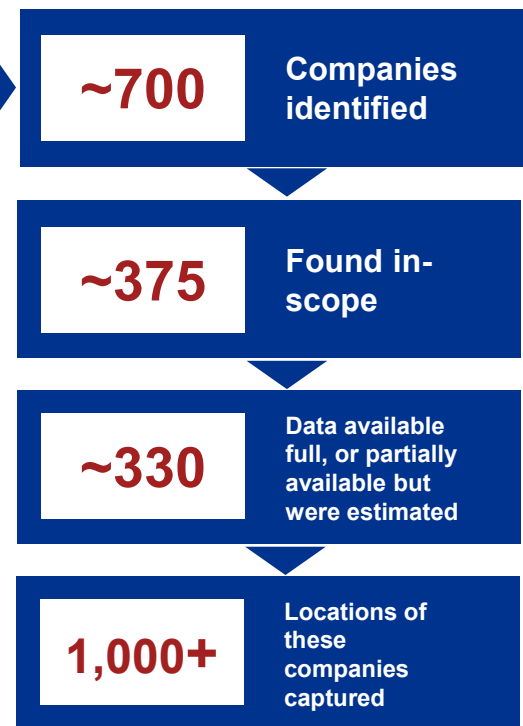


- Utilized external consultant to pore through studies, desktop research, supplier databases, news articles, etc. to get long list of potential companies across segments
- Pureplay personal vehicle manufacturers left out since the beginning
- All EV charger players included as chargers can be flexible by vehicle type
- See full list of sources utilized for company identification in the next page

- **In scope:** Companies whose products or services help differentiate the final vehicle as a commercial ZEV from an ICE vehicle; have employees in US; are not dissolved and have some minimal information available (website, HQ, etc.)
- **Out of Scope:** Adjacent industries e.g. bolts, utilities (except utilities providing infrastructure installation) and non-EV specific parts / ICE-only suppliers e.g. chassis (except for body manufacturing)

- **Part 1: Overall Company** – US financials and # employees from annual reports, D&B, CapIQ etc., ZEV share if available; segment; EV history; HQ, etc.
- **Part 2: Location Level Data** – Capture US HQ, all ZEV-relevant US locations but only the HQ for EV charging stations, utilities and ZEV dealers; location wise activities, employees, unions, investments, state agreements, etc.

- **US MHD ZEV revenue or employees:** If not stated publicly, estimated based on % EV share of backlog volumes, % share of EV products of total portfolio, or applying % commercial and EV share to overall revenue or # of employees
- **US/commercial revenue:** Estimated based on % share CV and % US share
- **Incumbent / New Entrant:** Companies historically related to ICE but now expanding to EV are 'incumbent', while pureplay EV players are 'new entrant'
- **Exceptions** exist e.g. charging infrastructure company revenues are not broken down to CV because of use for both, PV and CV



# Analysis referred to a large set of industry reports, SEC filings, press releases, internal studies and more to compile the long list (1 of 3)

## Specific Sources (1 of 2)

Title (Linked if available)	Publisher	Year	Segment(s) Covered	Comment
<a href="#">Automotive Supplier Consolidation Study 2020</a>	PwC (Internal)	2021	Manufacturing	Long list of automotive manufacturing suppliers; key data points (revenue, employees)
<a href="#">Economic potential of growing electric transportation in <u>CA</u>, <u>NY</u>, <u>IL</u> markets</a>	AEE, BW Research	2021	All	Select CA, NY, IL companies from each segment noted
<a href="#">Battery Critical Materials Supply Chain</a>	US DoE	2020	Manufacturing	Sector overview
<a href="#">Next-generation Battery Technology Report</a>	IHS Markit	2020	Manufacturing	Battery cell and battery pack manufacturers
<a href="#">Mineral Commodity Survey 2021</a>	U.S. Geological Survey	2021	Manufacturing	Battery raw materials suppliers
<a href="#">State of the EV lithium-ion battery market</a>	Prescouter	2020	Manufacturing	Battery raw materials suppliers, Battery cell and battery pack manufacturers
<a href="#">EV Powertrain Market Research Report</a>	Market Research Future	2021	Manufacturing	Electric motor and drivetrain players
<a href="#">Electric Motors for Electric Vehicle Market</a>	Mordor Intelligence	2020	Manufacturing	Electric motor players
<a href="#">Electric Vehicle Power Inverter Market</a>	Mordor Intelligence	2020	Manufacturing	EV Inverter players
<a href="#">EV Market Status report</a>	EDF / MJ Bradley	2021	Manufacturing	Vehicle Assembly
<a href="#">Top 71 Electric Car Startups</a>	Energy Startups dot Org	2021	Manufacturing, Infrastructure	Vehicle Assembly, EV Charging infrastructure players
<a href="#">ZEV Bus &amp; Truck Market in US &amp; Canada</a>	ICCT	2021	Manufacturing, Infrastructure	Vehicle Assembly, EV Charging infrastructure players
<a href="#">Top 10 EV Tech Solution Companies</a>	Auto Tech Outlook	2020	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Top 7 EV Stocks and Battery Companies</a>	US News	2021	Manufacturing	Vehicle Assembly
<a href="#">Sustainability Market Assessment</a>	PwC (Internal)	2020	Infrastructure	EV Charging infrastructure players
<a href="#">California Energy Commission announces new incentive program for ZEV truck and bus infra</a>	Charged EV Magazine	2021	Infrastructure	Key investments, state grants in CA EV Infrastructure segment; Key players
<a href="#">San-Francisco EV Infrastructure Working Paper</a>	ICCT	2020	Infrastructure	Sector overview

# Analysis referred to a large set of industry reports, SEC filings, press releases, internal studies and more to compile the long list (2 of 3)

## Specific Sources (2 of 2)

Title (Linked if available)	Publisher	Year	Segment(s) Covered	Comment
<a href="#">EV Stations Map by PlugShare</a>	PlugShare	Live	Infrastructure	Key EV charging infrastructure players identified
<a href="#">US EV Infrastructure Market</a>	Grand View Research	2021	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Electric Vehicle Charging Infrastructure Trends</a>	NREL	2020	Infrastructure	Key EV charging infrastructure players identified
<a href="#">PG&amp;E's Approved EV Charge Network vendors</a>	PG&E	Live	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Electric Vehicle Charging Station Market</a>	Research and Markets	2020	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Top 20 electric charging station companies</a>	News article	2019	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Top Electric Vehicle Charging Startups</a>	Tracxn	2021	Infrastructure	Key EV charging infrastructure players identified
<a href="#">EV charging infrastructure: Rising role of utilities</a>	ADI Analytics	-	Infrastructure	Key EV charging infrastructure players identified
<a href="#">Electric Vehicle Battery Swapping Market</a>	Allied Market Research	2021	Midlife	Battery swapping players
<a href="#">Top 10 international truck dealers in US</a>	Fue Loyal	2017	Midlife	Only 1 sells/services EV trucks
<a href="#">Dealers prepping for the inevitable shift toward electric vehicle service</a>	Transport Topics (News)	2021	Midlife	Only 1 sells/services EV trucks
<a href="#">Bus Dealers Distributors &amp; Sales</a>	Metro Online Directory	Live	Midlife	Some EV bus dealers and maintenance players
<a href="#">North American Commercial Vehicle Contract Maintenance Market, 2020</a>	Research and Markets	2020	Midlife	Vehicle Maintenance players (EV specific selected)
<a href="#">EV Test Equipment Market - Forecast to 2026</a>	Research & Markets	2021	R&D and Training	Key EV Testing players; EV Testing equipment manufacturers
<a href="#">EV Charging Systems Testing Market</a>	Allied Market Research	2021	R&D and Training	Report yet to be published; sourced key player names

# Analysis referred to a large set of industry reports, SEC filings, press releases, internal studies and more to compile the long list (3 of 3)

## Generic Sources

Title (Linked if available)	Publisher	Year	Segment(s) Covered	Comment
<a href="#">Capital IQ</a> (Licensed Database)	S&P Global	Live	All	Key company data (revenues, geography, employees, business description)
<a href="#">Dun &amp; Bradstreet</a> Business Directory	Dun & Bradstreet	Live	All	Key company data (revenues, employees, business description)
LinkedIn	Microsoft	Live	All	Key company data (employees, business description, HQ, geographies)
SEC <a href="#">Edgar</a>	SEC	Live	All	Key company data (revenues, geography, employees, business description)
Monster	-	Live	All	Key company data (employees, business description, jobs, salaries)
Glassdoor	-	Live	All	Key company data (employees, business description, jobs, salaries)
Investor Reports, Annual Reports	Company websites	Live	All	Key company data (revenues, geography, employees, business description)
Misc. News Articles on EV	-	Live	All	Smaller players, JVs, partnerships, etc. (Eg: Volvo & Mack trucks)
Google Ads	-	Live	All	Direct leads on segment players from Google Sponsored Ads

# Given the dynamic nature of the analyzed market, the study and database has a number limitations

## Limitations

### Company Identification:

- **Very small players:** Although a diverse set of resources has been leveraged to create a long list of companies, smaller or lesser known players might not appear in any of the sources cited. Given the dynamic and fast-paced environment, additional players might emerge that should be added to the database.
- **Terminology Differences:** Segments related to EV industry are still emerging and it is likely that some companies may have not been discovered if they use a different terminology to classify or brand their products and services.

### Scoping:

- **Limited Information:** Some companies were left out of scope if there was no or very limited information available publicly, for eg: lack of a website, or a website updated over 5 years ago indicating the player may have shut down operations.
- **Undisclosed EV portfolio:** Players, for which EV involvement could not be verified because they did not have publicly disclosed information about their EV capabilities on the website, annual reports, news or other public platforms, are excluded from the database.
- **No US Operations information:** Companies appearing operational in the US (e.g. some sales) but for which a local workforce could not be confirmed (no US location) on their website or in annual reports, are excluded from the database.

### Data Gathering and Estimation:

- **Revenue:** If not publicly disclosed on company website or annual reports, revenue numbers of alternative sources have been used. Additionally, in order to obtain revenue specific to the US, specific to commercial vehicles and specific to ZEV, assumptions based on the best reasonable approach have been made. Alternative sources and numbers based on assumptions are cross-checked but may not represent actual numbers.
- **Employees:** Similarly to revenue numbers, headcount sourced from sources other than company website or annual report to obtain location-specific may not be fully accurate. Assumptions based on best reasonable approach have been made.
- **ZEV share:** In many cases actual share of ZEV in business or headcount was not available directly, and hence estimations have been made wherever possible.
- **Union/Investment Announcements:** EV is a very active space in terms of investments, deals and expansion. Only most relevant announcements may have been captured and newer announcements might have been made already since the company research was completed.
- **Investments:** Most announcements mention 'committed' or 'estimated' capital spends and not the actual capital spent. Additionally, locations may not always do press releases about their ZEV investments, therefore, may remain undiscovered.
- **State Agreements:** While listed companies disclose state tax credits or incentives in annual reports, most private companies do not disclose the grants or support from state and therefore such information could have gone undiscovered
- **Unions:** Public companies disclose union information, however, unions seldom have dedicated websites or online announcement forums. Therefore, such information on latest union announcements is limited.