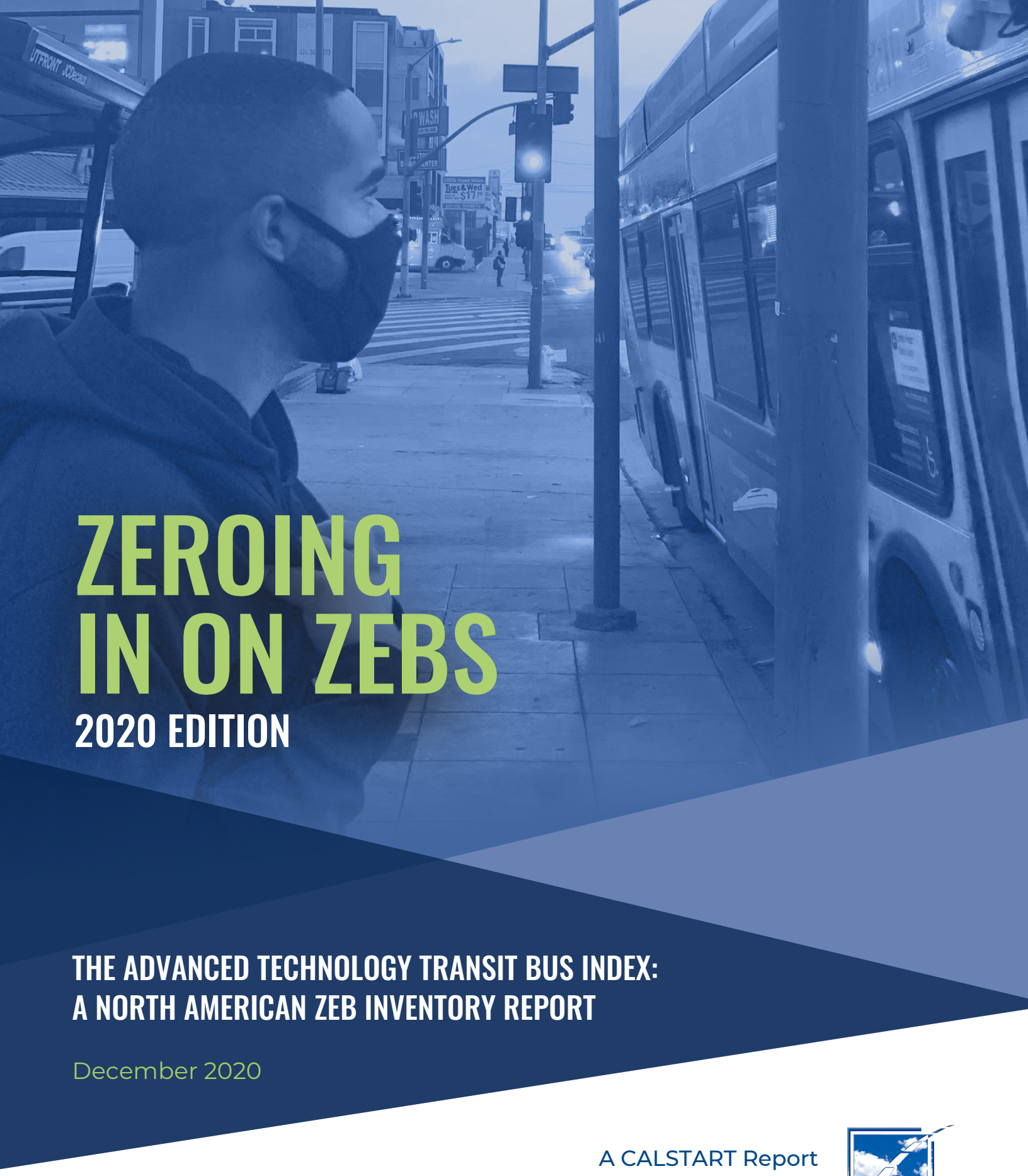

# ZEROING IN ON ZEBS

## 2020 EDITION

### THE ADVANCED TECHNOLOGY TRANSIT BUS INDEX: A NORTH AMERICAN ZEB INVENTORY REPORT

December 2020

A CALSTART Report
By John Jackson, Bryan Lee, and Fred Silver
www.calstart.org

This report was funded by funding from the Federal Transit Administration (FTA), and the California Air Resources Board (CARB) Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). 

This document is based on information gathered in December 2020. This is the 2020 edition of this document.

# List of Acronyms

| | |
|---|---|
| APTA | American Public Transit Association |
| BEB | Battery Electric Bus |
| CAA | Clean Air Act |
| CARB | California Air Resources Board |
| FCEB | Fuel Cell Electric Bus |
| FAA | Federal Aviation Administration |
| FTA | Federal Transit Administration |
| GVWR | Gross Vehicle Weight Rating |
| HVIP | Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project |
| ICT | Innovative Clean Transit |
| kW | kilowatt |
| LoNo | Federal Transit Administration Low or No Emissions Program |
| MOU | Memorandum of Understanding |
| MW | Megawatt |
| TIRCP | Transit and Intercity Rail Capital Program |
| TIUOO | Total In-Use or On-Order |
| U.S. | United States of America |
| ZEB | Zero-Emission Bus |

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## Executive Summary

Since the creation of the Clean Air Act (CAA), the federal government has been working with public and private organizations to reduce the amount of pollution released into the atmosphere. Transit buses have historically and predominantly operated on diesel fuel. Although buses produce less smog per capita than cars, they still release toxic fumes like nitrous oxide directly into urban communities.

Between 2013 and 2020, the Federal Transit Administration (FTA) has distributed over $485 million for hybrids, battery electric, and hydrogen fuel cell buses via the Low or No-emission Bus Program. State-level grant programs, such as California's Transit and Intercity Rail Capital Program (TIRCP), have also supported the adoption of zero-emission buses (ZEBs). Additionally, money from the 2016 Volkswagen settlement has been made available to states to purchase zero-emission vehicles. Over the last decade, the rise in ZEBs has increased across the country. The number of ZEBs purchased by transit agencies, universities, and private entities has continued to grow as these organizations are continuously taking advantage of the evolving electric and fuel cell vehicle technology.

However, quantifying this increase has been difficult. Funding bodies like the FTA and TIRCP have tracked the number of buses they have supported, but do not assess how many ZEBs exist overall. Some state agencies, like the California Air Resources Board (CARB), have produced high quality maps of where ZEBs are, but only within their jurisdiction or accounting for a particular technology rather than an across the board index of all types of ZEBs. Tracking this data nationally is an important exercise because it helps offers important context into the United States' progress toward adopting this critical technology. ZEBs are a foundational commercial vehicle market segment where zero-emission and near-zero technology is most likely to succeed first and can also contribute to the development of vehicles in other segments.

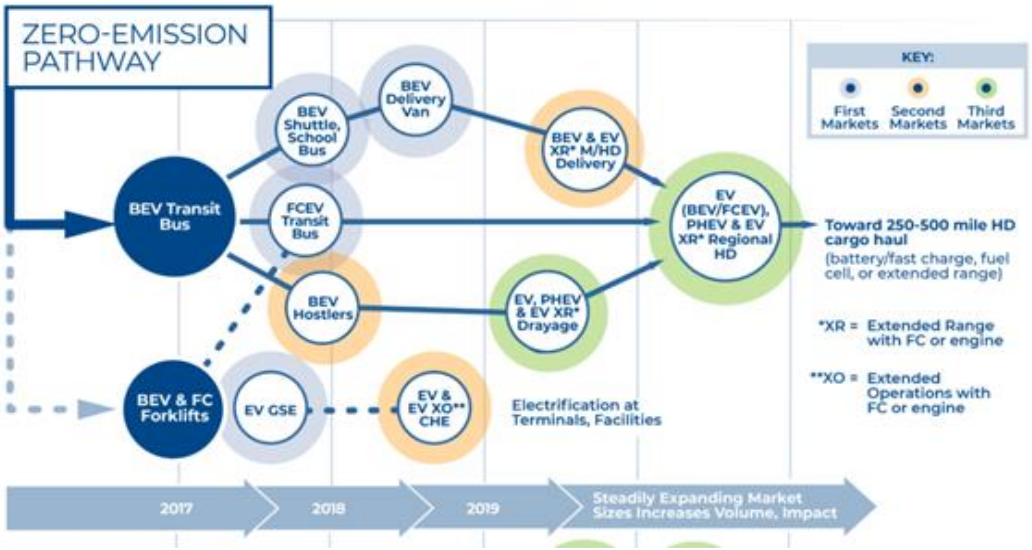



*Figure 1: Zero Emission Pathways*

*As shown in the graphic above, developed by CALSTART for its Global Commercial Drive to Zero program, the technologies/components found in battery electric transit buses can be used in electric shuttle and school buses, electric delivery vans, electric hostlers and other vehicles*[1]

This report seeks to remedy this problem. Zero-emissions buses are still relatively new in the transit world. As this form of transportation technology expands, it is important to keep track of the transition from buses that run on fossil fuels and near-zero-emission fuels, to ones that are entirely zero-emissions. Through extensive research and outreach, this report aims to do exactly that. Enclosed is a breakdown of all zero-emission buses, categorized by battery electric buses and hydrogen fuel cell buses, for every state in the in the country. A list of transit agencies who are actively operating, ordering, or have received funding for ZEBs is shown next. Lastly, a map of the country, as well as a close-up view of every state, is displayed with all the aforementioned transit agency's logos.

This report also projects the number of active buses, small buses, and airport transit buses in the U.S. This report also highlights ZEB deployments in Canada. This is the first year that this report has tracked this data for Canada. Active buses are defined as buses that are on the road today. Highlighting these puts in perspective the likelihood of the average person seeing a ZEB on the road today. While the primary numbers in this report reflect the number of zero-emissions buses on order and actively on the road, it is important that the active buses are also singled out for perspective.

[1] CALSTART Beachhead Zero Emissions Pathways, CALSTART 2018

# Results and Analysis of Survey

As of December 2020, there are:

| | |
|---|---|
| Total U.S. Zero-Emission Transit Buses (ZEBs) | **2,790** |
| U.S. Transit Battery Electric Buses (BEBs) | **2,703** |
| U.S. Transit Hydrogen Fuel Cell Buses (FCEBs) | **87** |
| U.S. Zero-Emissions Small Buses | **617** |
| Active U.S. Zero-Emissions Transit Buses | **1015** |
| Canadian Zero-Emissions Transit Buses | **249** |

Zero-emission transit buses nationally have grown to almost 2,800 buses on the road or on order, an increase of 24 percent over the last calendar year. The region of the country with the most buses was the West Coast (Washington, Oregon, and California), with over half in that region alone. California, a state where all transit buses must be zero-emission by 2040 according to the Innovative Clean Transit (ICT) regulation, had the highest number of ZEBs with over 1100. The median number of ZEBs per transit property nationwide was six, while the median number in California was nine. The smallest ZEB fleet in the United States has one bus. The largest ZEB fleet has 129 buses. The largest battery electric buses (BEB) fleet has 129 buses and the largest fuel cell electric bus (FCEB), fleets has 24 buses.

Most fleets in the United States have five or fewer ZEBs and the vast majority have ten or less (see Figure 2). This demonstrates that most of the fleets are small and more effort and resources will need to be devoted to helping these fleets to overcome the barriers to scaling. However, some fleets have begun to achieve deployments at scale. Currently there are 33 transit properties across the U.S. that have at least 20 ZEBs in operation or on order. Of these 33 properties, 17 are in California and have a mean of 43 buses per property. The other 16 are located in Washington, Utah, Nevada, Delaware, Rhode Island, Illinois, Indiana, Georgia, Pennsylvania, New Mexico, Florida, and Colorado.

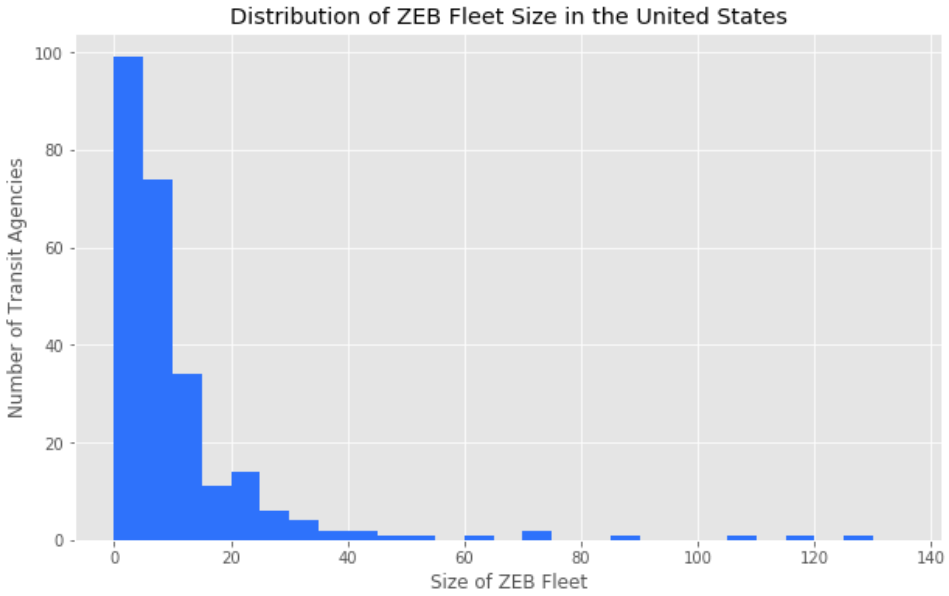



*Figure 2: Distribution of ZEB Fleet Size in the United States*

California is the state with the most ZEB deployments. California also has the majority of the larger ZEB deployments. However, despite this, the majority of California's transit agencies have a ZEB fleet that is smaller than 10 buses (see Figure 3), indicating that California will also need to provide resources to help scale up its smaller fleets.

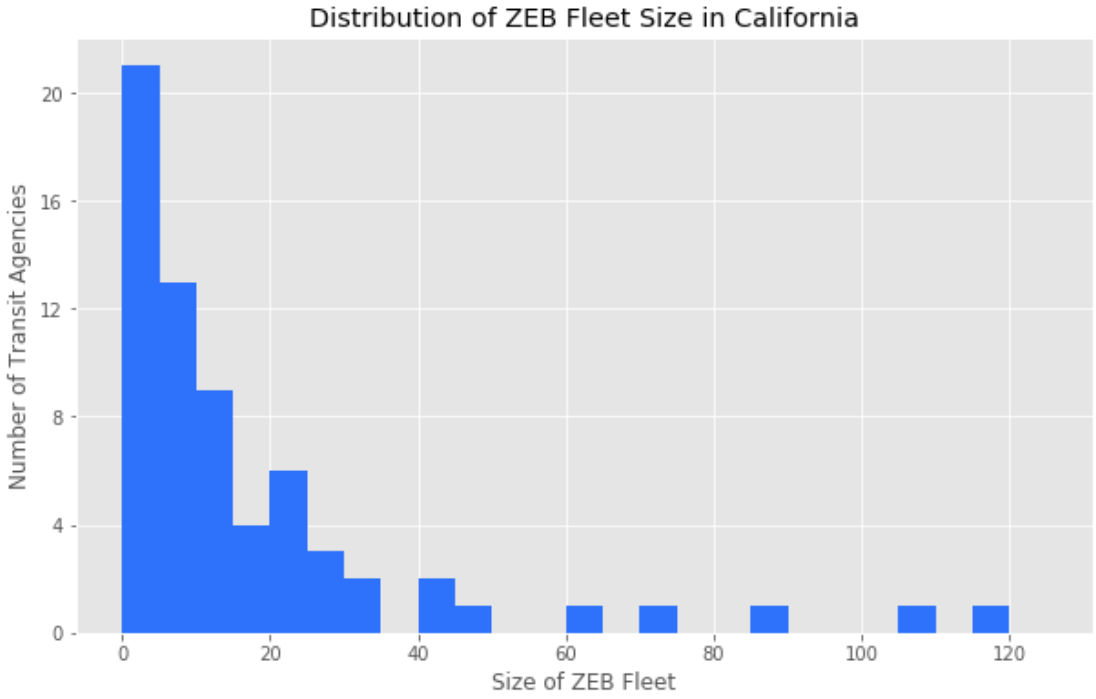



*Figure 3: Distribution of ZEB Fleet Size in California*

At this point in time, BEBs are the most common form of ZEBs on the road compared to FCEB. This can be attributed to a variety of factors including cost, infrastructure, and agency preference. However, since many transit agencies have extended routes (see Figure 4), many transit agencies are considering deploying FCEBs. As a result, it is likely that there will be an increase in FCEB deployments in the future.

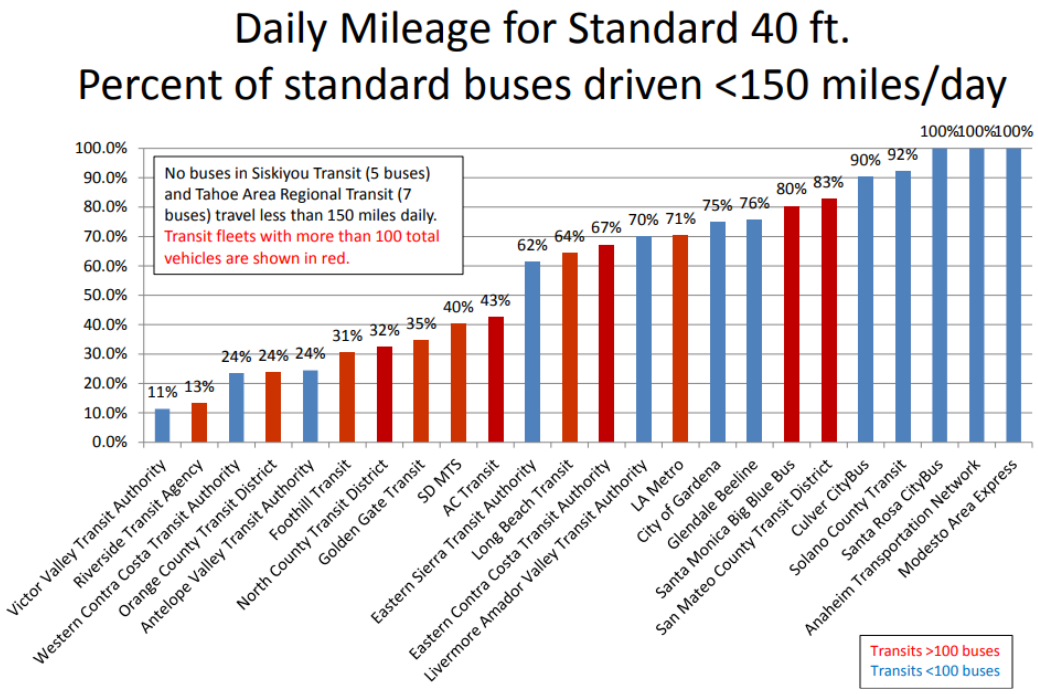



*Figure 4: Transit Agencies with Extended Routes*[3]

In total, there were 229 agencies that had ZEBs or had them on order in the United States (an increase of 53 from 2019), and eight in Canada. Of those 229 agencies, 57 of them are in California. Forty-four states, Washington D.C., and Guam have zero emission buses. Arkansas, Maine, New Hampshire, North Dakota, South Dakota, and West Virginia are the only states that do not yet have ZEBs. No new states added zero-emission buses this year compared to four in last year's count.

[3] California Air Resources Board. (2016)."Transit Agency Survey Preliminary Results." ACT Workgroup Meeting. Available at: https://ww3.arb.ca.gov/msprog/bus/transit_survey_summary.pdf

# Important Notes About This Report

1) The data for this report has been gathered primarily through award documents, press releases, phone interviews, and other methods of validation. As there is no centralized accounting of zero-emission buses, and transit agency plans for adoption can shift and/or be delayed, it is important to note that figures contained should not be considered static. Data collection is ongoing, and this index will be updated annually. If you have information about a zero-emission bus deployment that is not featured in this report, please reach out to John Jackson (jjackson@calstart.org), Bryan Lee (blee@calstart.org), or Fred Silver (fsilver@calstart.org).

2) Despite becoming much more popular among transit agencies, ZEBs are still advanced technology, and they can take months, if not years, for bus manufacturers to build and deliver the vehicles. Determining what buses are operating today and what buses are on order is a function of time, and any attempt to do so would become immediately outdated. This report tracks all ZEBs known to be operating today, on order, or at least have been awarded funding for the transit agency to purchase. This report occasionally uses the acronym "TIUOO" to refer to the "Total In-Use or On-Order" number of ZEBs, referring to the number of buses that are active on the roads and currently on-order to be delivered in the future.

3) The figures for the "Active U.S. Transit Zero-Emissions Buses" come from the American Public Transit Association (APTA) 2020 Fact Book, CALSTART's bus census (FY17 and 18), and bus sales information from bus manufacturers BYD, Proterra, and Nova, and data from redeemed CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) transit bus vouchers.

4) This report counts the ZEBs known as of December 2020 as described in the previous note. All future versions of this report will similarly be a specific snapshot of a single day, date marked in the title of the report.

5) Zero-emission transit buses that are privately owned and not being used for transit revenue service are also counted in this report.

# Section 1: United States Zero Emission Transit Bus Count

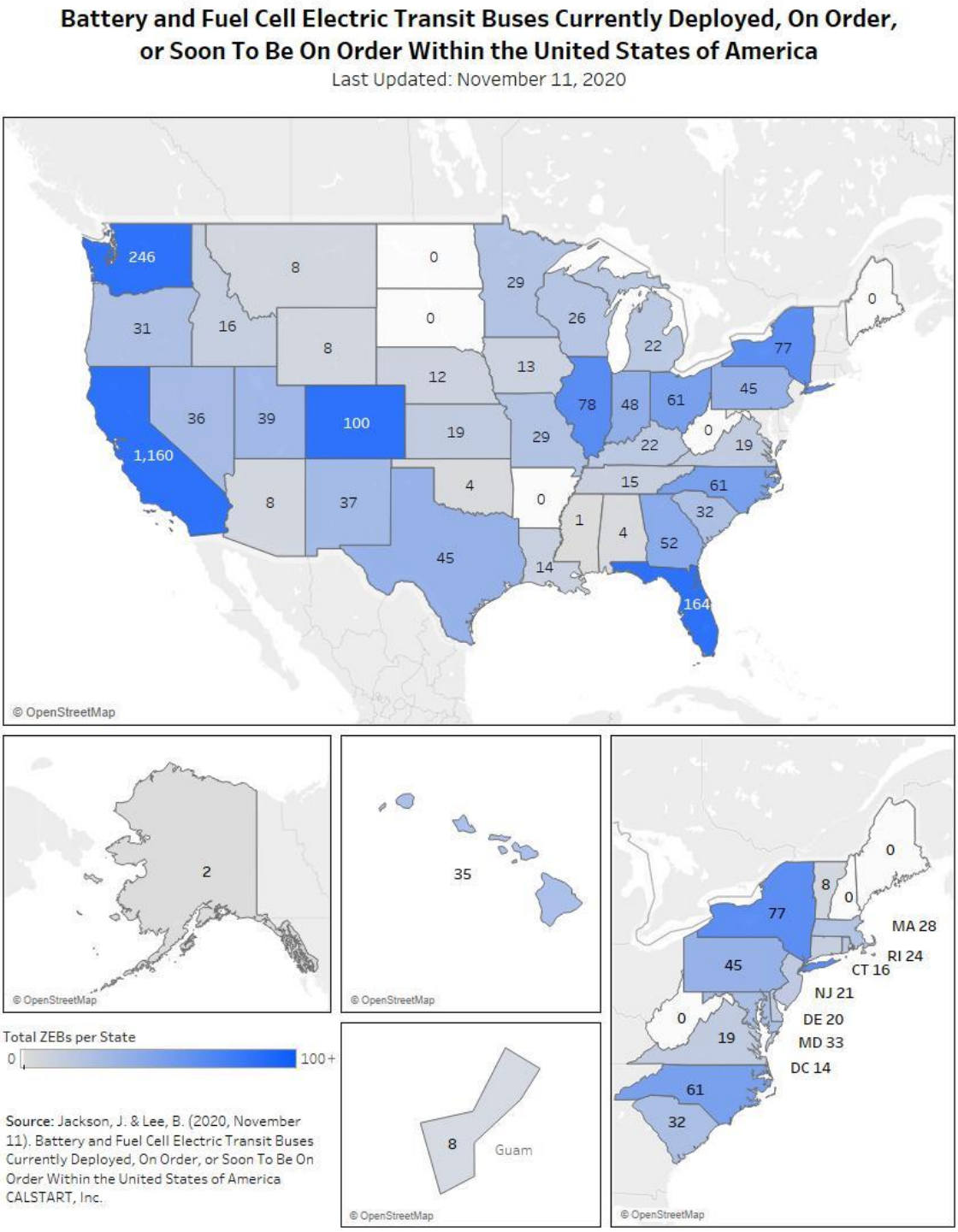



*Figure 5: United States Zero-Emission Bus Map*

The United States has 2,790 zero emission transit buses on order or deployed. Figure 7 provides a breakdown of the number of ZEBs deployed by state across the United States. Table 1 further disaggregates this data and provides a state-by-state breakdown of the number of BEBs and FCEBs deployed. These buses are deployed across 255 transit agencies. The transit agencies with ZEBs have been mapped out in Section 2. A list of these transit agencies can also be found in Appendix A.

## Table 1: State-By-State Zero-Emission Bus Distribution

## Total Buses = 2,790

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Alabama | AL | 3 | 1 | 4 |
| Alaska | AK | 2 | 0 | 2 |
| Arizona | AZ | 8 | 0 | 8 |
| Arkansas | AR | 0 | 0 | 0 |
| California | CA | 1108 | 52 | 1160 |
| Colorado | CO | 100 | 0 | 100 |
| Connecticut | CT | 16 | 0 | 16 |
| Delaware | DE | 20 | 0 | 20 |
| District of Columbia | DC | 14 | 0 | 14 |
| Florida | FL | 164 | 0 | 164 |
| Georgia | GA | 52 | 0 | 52 |
| Hawaii | HI | 34 | 1 | 35 |
| Idaho | ID | 16 | 0 | 16 |
| Illinois | IL | 74 | 4 | 78 |
| Indiana | IN | 48 | 0 | 48 |
| Iowa | IA | 13 | 0 | 13 |
| Kansas | KS | 19 | 0 | 19 |
| Kentucky | KY | 22 | 0 | 22 |
| Louisiana | LA | 14 | 0 | 14 |
| Maine | ME | 0 | 0 | 0 |
| Maryland | MD | 33 | 0 | 33 |
| Massachusetts | MA | 27 | 1 | 28 |
| Michigan | MI | 20 | 2 | 22 |
| Minnesota | MN | 29 | 0 | 29 |
| Mississippi | MS | 1 | 0 | 1 |
| Missouri | MO | 29 | 0 | 29 |
| Montana | MT | 8 | 0 | 8 |

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Nebraska | NE | 12 | 0 | 12 |
| Nevada | NV | 34 | 2 | 36 |
| New Hampshire | NH | 0 | 0 | 0 |
| New Jersey | NJ | 21 | 0 | 21 |
| New Mexico | NM | 37 | 0 | 37 |
| New York | NY | 77 | 0 | 77 |
| North Carolina | NC | 61 | 0 | 61 |
| North Dakota | ND | 0 | 0 | 0 |
| Ohio | OH | 37 | 24 | 61 |
| Oklahoma | OK | 4 | 0 | 4 |
| Oregon | OR | 31 | 0 | 31 |
| Pennsylvania | PA | 45 | 0 | 45 |
| Rhode Island | RI | 24 | 0 | 24 |
| South Carolina | SC | 32 | 0 | 32 |
| South Dakota | SD | 0 | 0 | 0 |
| Tennessee | TN | 15 | 0 | 15 |
| Texas | TX | 45 | 0 | 45 |
| Utah | UT | 39 | 0 | 39 |
| Vermont | VT | 8 | 0 | 8 |
| Virginia | VA | 19 | 0 | 19 |
| Washington | WA | 246 | 0 | 246 |
| West Virginia | WV | 0 | 0 | 0 |
| Wisconsin | WI | 26 | 0 | 26 |
| Wyoming | WY | 8 | 0 | 8 |
| Guam | GU | 8 | 0 | 8 |
| **Total** | | **2703** | **87** | **2790** |

Tables 2-10 provide a regional breakdown of ZEB distribution. These tables provide a state-by-state breakdown of ZEB distribution by FTA Region and provide growth statistics for ZEB deployments as compared to 2019. ZEB growth occurred in every FTA region in the past year. The region with the highest growth rate was in the Midwest in FTA Region 7 with a growth rate of 128% compared to last year's ZEB Count. This region more than doubled the amount of ZEBs in each state, with the highest amount of growth coming from the state of Missouri, which added 18 ZEBs all which are battery electric. The region with the lowest growth rate was Region 9 in the Southwest U.S., which includes California. This can be attributed to the already large number of ZEBs in that region, particularly in California.

## Table 2: FTA Region 1 State-By-State Zero-Emission Bus Distribution

## Total Buses = 76 (111% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Connecticut | CT | 16 | 0 | 16 |
| Maine | ME | 0 | 0 | 0 |
| Massachusetts | MA | 27 | 1 | 28 |
| New Hampshire | NH | 0 | 0 | 0 |
| Rhode Island | RI | 24 | 0 | 24 |
| Vermont | VT | 8 | 0 | 8 |
| **Total** | | **75** | **1** | **76** |

## Table 3: FTA Region 2 State-By-State Zero-Emission Bus Distribution

## Total Buses = 98 (78% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| New Jersey | NJ | 21 | 0 | 21 |
| New York | NY | 77 | 0 | 77 |
| **Total** | | **98** | **0** | **98** |

## Table 4: FTA Region 3 State-By-State Zero-Emission Bus Distribution

## Total Buses = 131 (13% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Delaware | DE | 20 | 0 | 20 |
| District of Columbia | DC | 14 | 0 | 14 |
| Maryland | MD | 34 | 0 | 34 |
| Pennsylvania | PA | 45 | 0 | 45 |
| Virginia | VA | 19 | 0 | 19 |
| West Virginia | WV | 0 | 0 | 0 |
| **Total** | | **131** | **0** | **131** |

## Table 5: FTA Region 4 State-By-State Zero-Emission Bus Distribution

## Total Buses = 290 (6.5% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Alabama | AL | 3 | 1 | 4 |
| Florida | FL | 164 | 0 | 164 |
| Georgia | GA | 52 | 0 | 52 |
| Kentucky | KY | 22 | 0 | 22 |
| Mississippi | MS | 1 | 0 | 1 |
| South Carolina | SC | 32 | 0 | 32 |
| North Carolina | NC | 61 | 0 | 61 |
| Tennessee | TN | 15 | 0 | 15 |
| **Total** | | **289** | **1** | **289** |

## Table 6: FTA Region 5 State-By-State Zero-Emission Bus Distribution

## Total Buses = 264 (25% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Illinois | IL | 74 | 4 | 78 |
| Indiana | IN | 48 | 0 | 48 |
| Michigan | MI | 20 | 2 | 22 |
| Minnesota | MN | 29 | 0 | 29 |
| Ohio | OH | 37 | 24 | 61 |
| Wisconsin | WI | 26 | 0 | 26 |

## Table 7: FTA Region 6 State-By-State Zero-Emission Bus Distribution

## Total Buses = 127 (62% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Arkansas | AR | 0 | 0 | 0 |
| Louisiana | LA | 14 | 0 | 14 |
| New Mexico | NM | 37 | 0 | 37 |
| Minnesota | MN | 29 | 0 | 29 |
| Oklahoma | OK | 4 | 0 | 4 |
| Texas | TX | 45 | 0 | 45 |

## Table 8: FTA Region 7 State-By-State Zero-Emission Bus Distribution

## Total Buses = 73 (128% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Iowa | IA | 13 | 0 | 13 |
| Kansas | KS | 19 | 0 | 19 |
| Missouri | MO | 29 | 0 | 29 |
| Nebraska | NE | 12 | 0 | 12 |

## Table 9: FTA Region 8 State-By-State Zero-Emission Bus Distribution

## Total Buses = 155 (49% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Colorado | CO | 100 | 0 | 100 |
| Montana | MT | 8 | 0 | 8 |
| North Dakota | ND | 0 | 0 | 0 |
| South Dakota | SD | 0 | 0 | 0 |
| Utah | UT | 39 | 0 | 39 |
| Wyoming | WY | 8 | 0 | 8 |

## Table 10: FTA Region 9 State-By-State Zero-Emission Bus Distribution

## Total Buses = 1239 (15% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Arizona | AZ | 8 | 0 | 8 |
| California | CA | 1108 | 52 | 1160 |
| Hawaii | HI | 34 | 1 | 35 |
| Nevada | NV | 34 | 2 | 36 |

## Table 11: FTA Region 10 State-By-State Zero-Emission Bus Distribution

## Total Buses = 295 (26% Growth from 2019)

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Alaska | AK | 2 | 0 | 2 |
| Idaho | ID | 16 | 0 | 16 |
| Oregon | OR | 31 | 0 | 31 |
| Washington | WA | 246 | 0 | 246 |

Table 12 outline the twenty states with the most ZEBs. These twenty states have 2,410 of the 2,790 buses in the nation. This demonstrates that there is an enormous disparity in the size of fleets between states. It also demonstrates that there are many states that still have few deployments.

## Table 12: Top 20 States with Zero-Emission Buses

## Total Buses = 2410

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| California | CA | 1108 | 52 | 1160 |
| Washington | WA | 246 | 0 | 246 |
| Florida | FL | 164 | 0 | 164 |
| Colorado | CO | 100 | 0 | 100 |
| Illinois | IL | 74 | 4 | 78 |
| New York | NY | 77 | 0 | 77 |
| North Carolina | NC | 61 | 0 | 61 |
| Georgia | GA | 52 | 0 | 52 |
| Indiana | IN | 48 | 0 | 48 |
| Ohio | OH | 37 | 24 | 61 |
| Pennsylvania | PA | 45 | 0 | 45 |
| Texas | TX | 45 | 0 | 45 |
| Utah | UT | 39 | 0 | 39 |
| New Mexico | NM | 37 | 0 | 37 |
| Hawaii | HI | 34 | 1 | 35 |
| Nevada | NV | 34 | 2 | 36 |
| Maryland | MD | 34 | 0 | 34 |
| South Carolina | SC | 32 | 0 | 32 |
| Oregon | OR | 31 | 0 | 31 |
| Minnesota | MN | 29 | 0 | 29 |

California has the largest ZEB fleet in the United States. Washington and Florida have the second and third largest fleets in the country. It is important to note that there is a huge disparity between California, which is the largest fleet, the size of California's fleet, and Washington State which is the nation's second largest fleet. Given that California was an early adopter of ZEB technology, it is not surprising that much of the early growth has been concentrated in California. CALSTART aims to narrow this gap by accelerating ZEB adoption across the country. The data reveals interesting geographic insights.

Many of the top 20 states with ZEBs are located on the coasts of the U.S. While the West Coast leads the nation for geographic region with the most ZEBs, portions of the Midwest and southern U.S. are close seconds and thirds with their ZEB counts. Currently there are 33 transit properties across the U.S. that have at least 20 ZEBs in operation or on order. Of these 33 properties, 17 are in California and have a mean of 43 buses per property. The other 16 are located in Washington, Utah, Nevada, Delaware, Rhode Island, Illinois, Indiana, Georgia, Pennsylvania, New Mexico, Florida, and Colorado. This data also falls in line with states that have created statewide mandates to fully transition their transit buses to zero-emissions by a certain date. In 2018, CARB approved a measure requiring public transit agencies to transition to 100% zero-emissions buses by 2040.

Since then, 15 states and the District of Columbia have joined a memorandum of understanding (MOU) to transition all medium and heavy-duty vehicles in their prospective states by 2050, with a target of 30 percent zero-emissions vehicle sales by 2030. This includes transit buses. The states that have signed onto this MOU in addition to California include Connecticut, Colorado, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington.[4] The total number of active buses in the United States has grown steadily over the last decade. As of 2020, there are 1016 ZEBs that have been actively deployed and are in physical possession of the transit agencies. As more agencies apply for more funding both federally and locally, more buses are being purchased to meet the needs, and in many cases requirements, of transitioning to an emission's free bus fleet. While many agencies have buses on order, it is important to highlight the buses that are actively on the road. Particularly in the states that have made the commitment to transition their transit bus fleets to complete zero-emissions by certain dates, emphasis has been put on not only finding ways to fund these buses, but also retrofitting existing infrastructure to accommodate them.

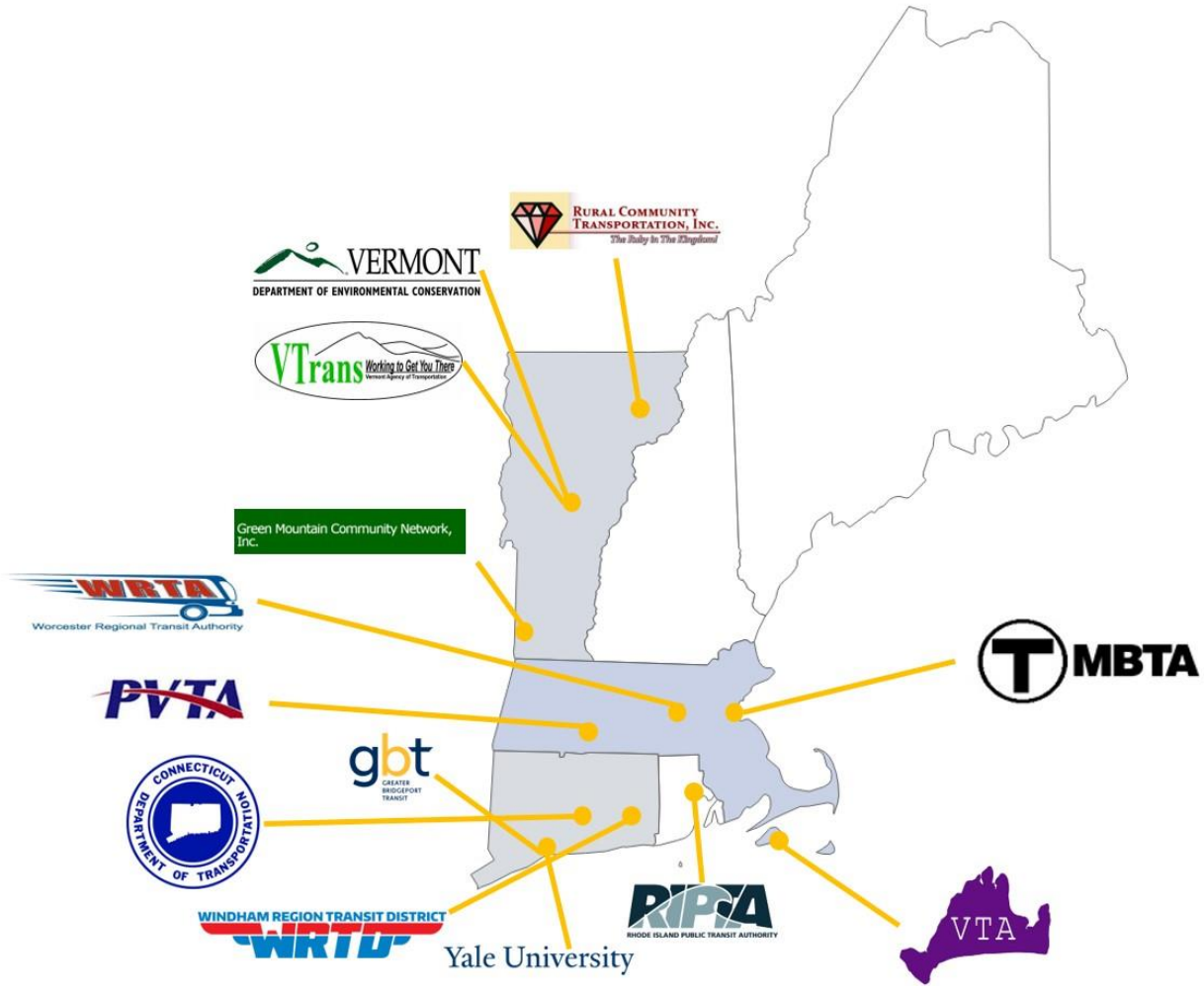
Once buses are ordered, the time from order to delivery typically takes about a year. This can vary per agency and can be attributed to aspects such as the amount of funding the agency has for buses or the infrastructure currently in place to receive zero-emissions buses, to name a few. A state-by-state breakdown of active ZEB deployments can be found in Appendix B and a list of the transit agencies with active deployments can be found in Appendix C.

[4]California Air Resources Board. (2020, July 14). Retrieved December 08, 2020, from https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification

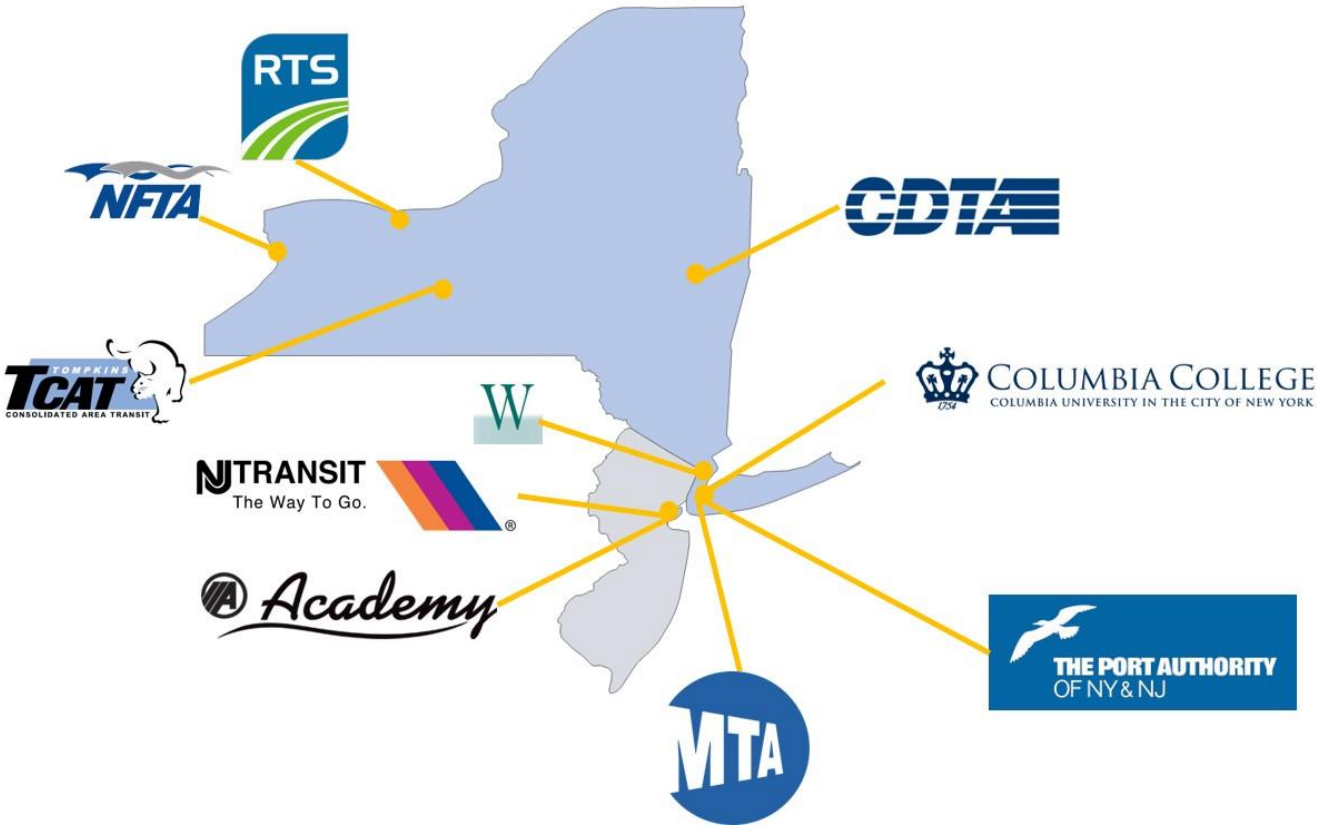
## Section 2: US Transit Properties Logo Map, By FTA Regions

Figures 6 – 16 map out the transit agencies that have ordered or deployed ZEBs. These maps are broken out by FTA Region. A list of transit agencies with ZEBs on order or deployed can be found in Appendix A.

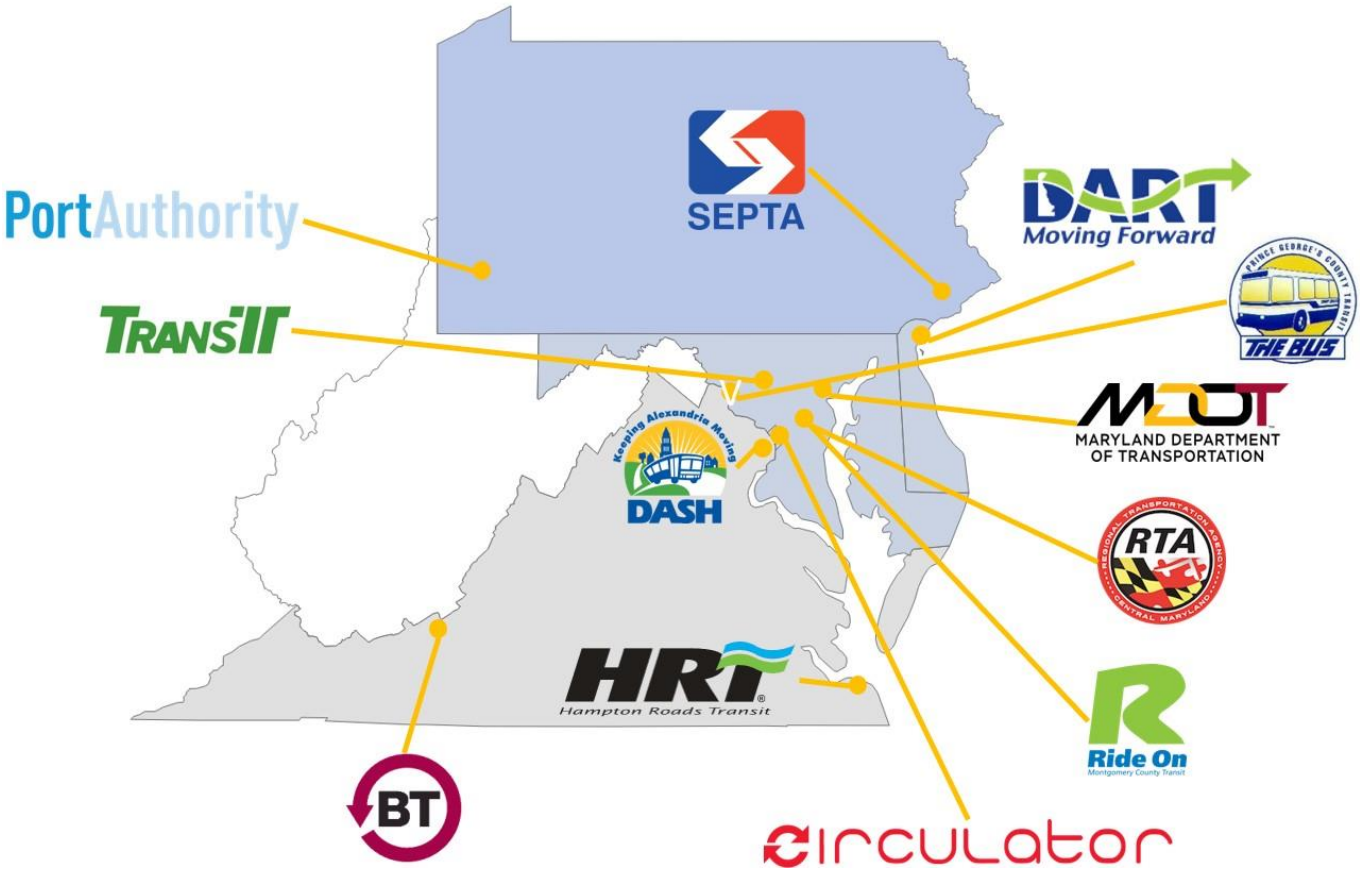
### Figure 6: FTA Region 1



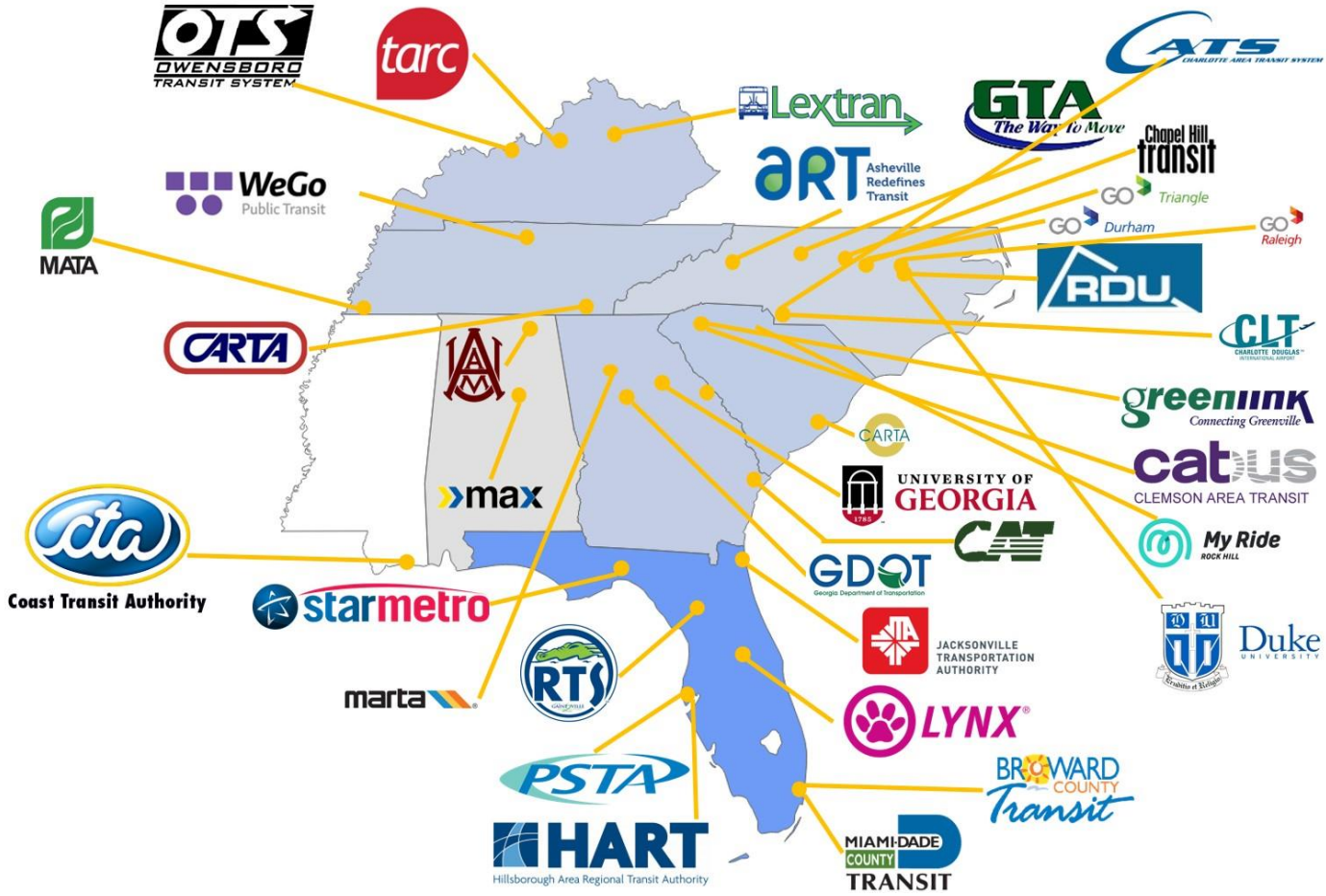
## Figure 7: FTA Region 2



## Figure 8: FTA Region 3

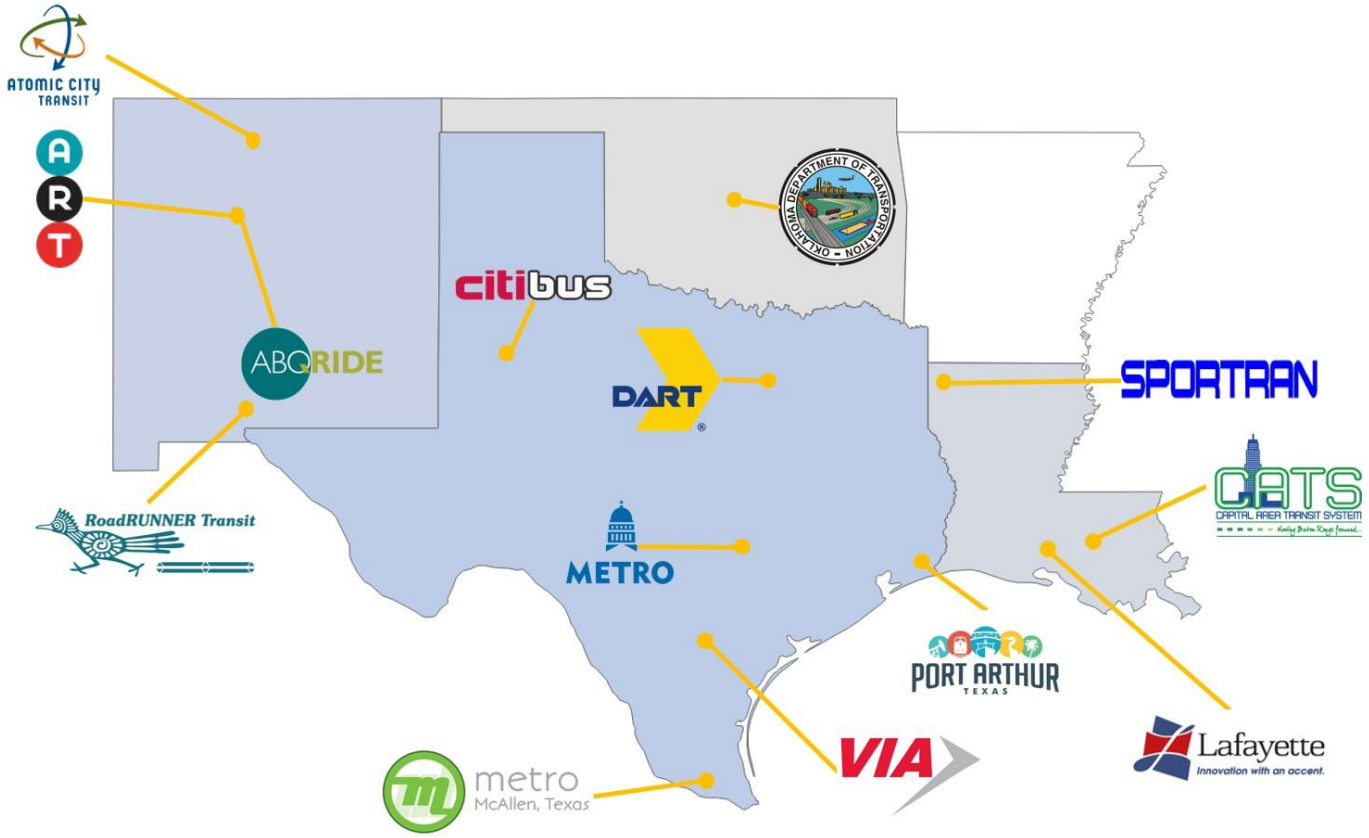


## Figure 9: FTA Region 4

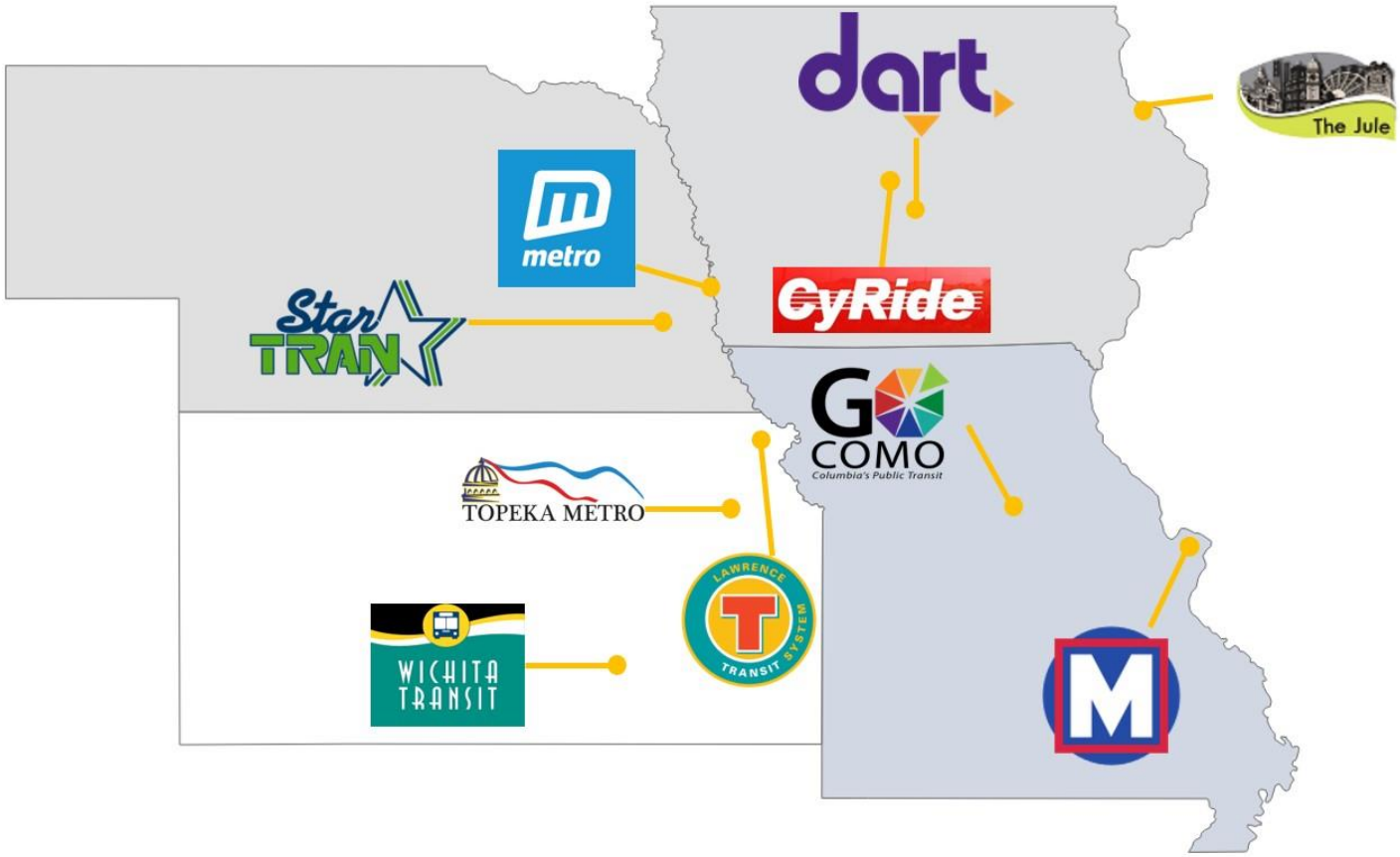


## Figure 10: FTA Region 5

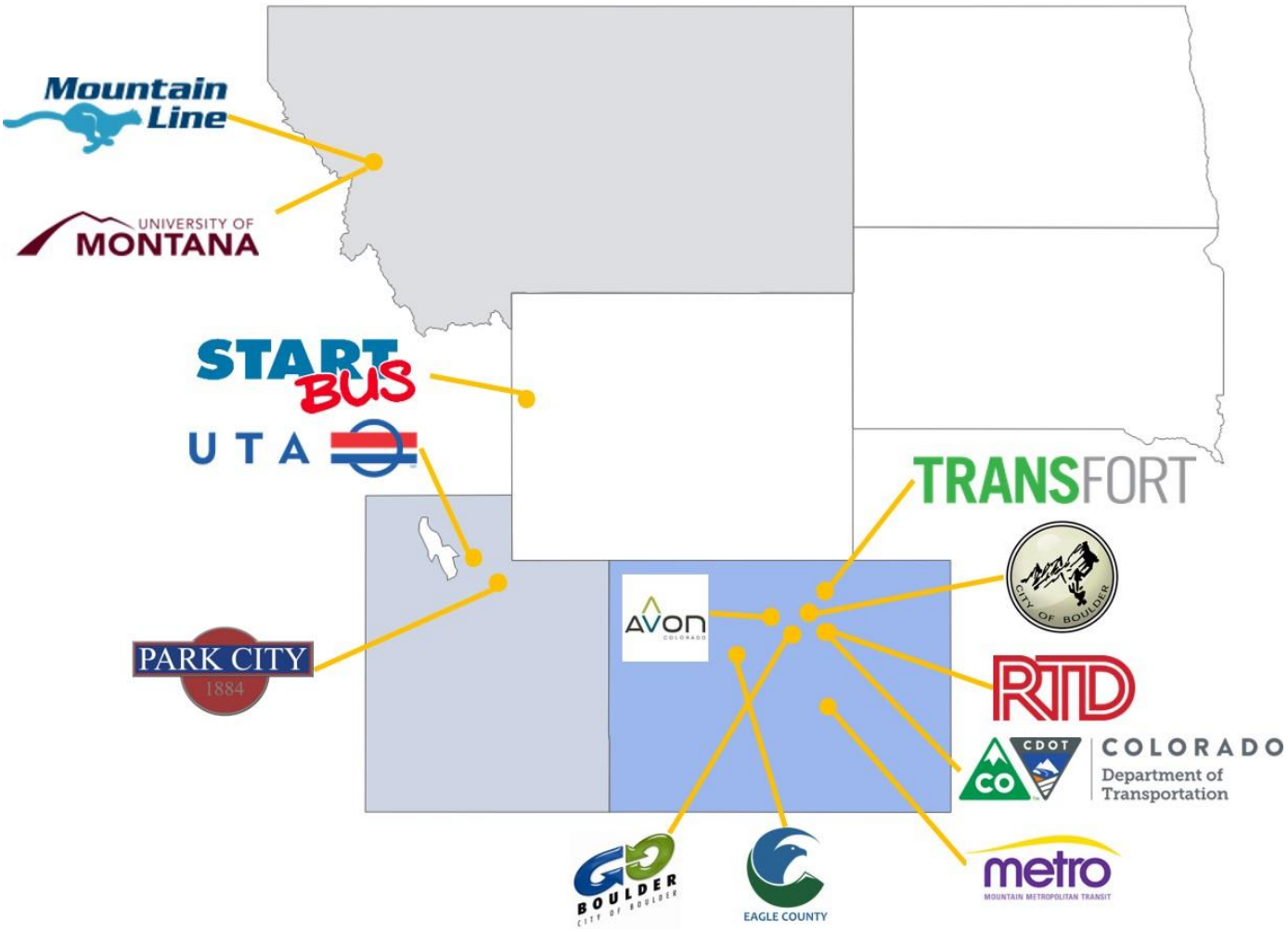
## Figure 11: FTA Region 6



## Figure 12: FTA Region 7



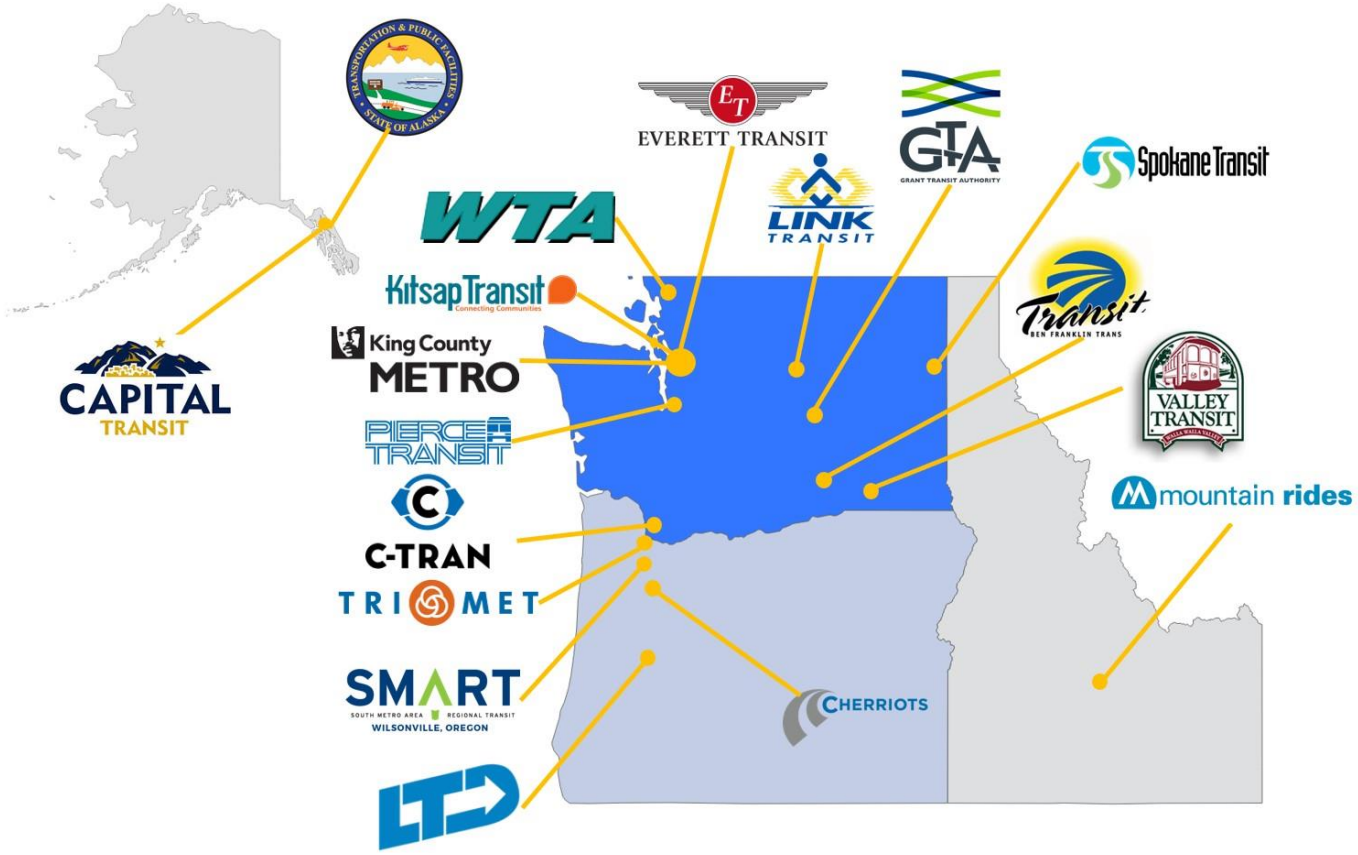
## Figure 13: FTA Region 8



## Figure 14: FTA Region 9 (Without California)

## Figure 15: FTA Region 9 (California)

## Figure 16: FTA Region 10



## Section 3: Canadian Zero Emission Transit Bus Count

One of the new elements of this year's inventory report is the inclusion of Canadian ZEBs. This data was gathered by a combination of original research as well as reaching out to various bus manufacturers regarding bus sales in the country to date. Canada shares a common supply chain for both Transit Buses and its associated infrastructure. As we envision that the costs for ZEBs to decrease over the next five years the additional volumes associated with Canada will prove to be valuable in this effort. In addition, the Canadian government has pledged to put 5,000 zero-emissions buses, both transit and school buses, on the roads by 2025. This commitment also pledges to build 5,000 electrical charging stations along the Trans-Canada Highway, as well as other roads across the country.[5]

Canada in the last decade has procured over 200 zero-emissions buses in all of its largest cities, including ones in its smallest. There are buses located in six of its 10 provinces stretching from British Columbia to Quebec. Growth in the Canadian market with ZEB technology continues to expand as more transit agencies across the world continue to transition their bus fleets to electric. Transit agencies in Montreal and British Columbia have committed themselves to having completely zero-emissions fleets by 2040.

### Table 13: Canadian Transit Properties Bus with Battery Electric or Fuel Cell Transit Buses

| # | Province | City | Transit Agency |
|---|---|---|---|
| 1. | Ontario | Brampton | Brampton Transit |
| 2. | Alberta | Edmonton | Edmonton Transit Service (ETS) |
| 3. | Quebec | Montreal | Montreal Metro (STM) |
| 4. | Ontario | Oakville | Oakville Transit |
| 5. | Saskatchewan | Saskatoon | Saskatoon Transit |
| 6. | Ontario | Toronto | Toronto Transit Commission (TTC) |
| 7. | British Columbia | Vancouver | TransLink |
| 8. | Manitoba | Winnipeg | Winnipeg Transit |

[5] *Zero-Emission Vehicles: Our Platform - Canada. (2020).* Available at: https://liberal.ca/our-platform/zero-emission-vehicles/

## Table 14: Zero-Emissions Transit Buses by Canadian Province

## Total # = 249

| Province | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Alberta | AB | 40 | 0 | 40 |
| British Columbia | BC | 4 | 0 | 4 |
| Manitoba | MB | 4 | 0 | 4 |
| New Brunswick | NB | 0 | 0 | 0 |
| Newfoundland and Labrador | NL | 0 | 0 | 0 |
| Nova Scotia | VS | 0 | 0 | 0 |
| Ontario | ON | 170 | 0 | 170 |
| Prince Edward Island | PE | 0 | 0 | 0 |
| Quebec | QC | 30 | 0 | 30 |
| Saskatchewan | SK | 1 | 0 | 1 |
| **Total** | | **249** | **0** | **249** |

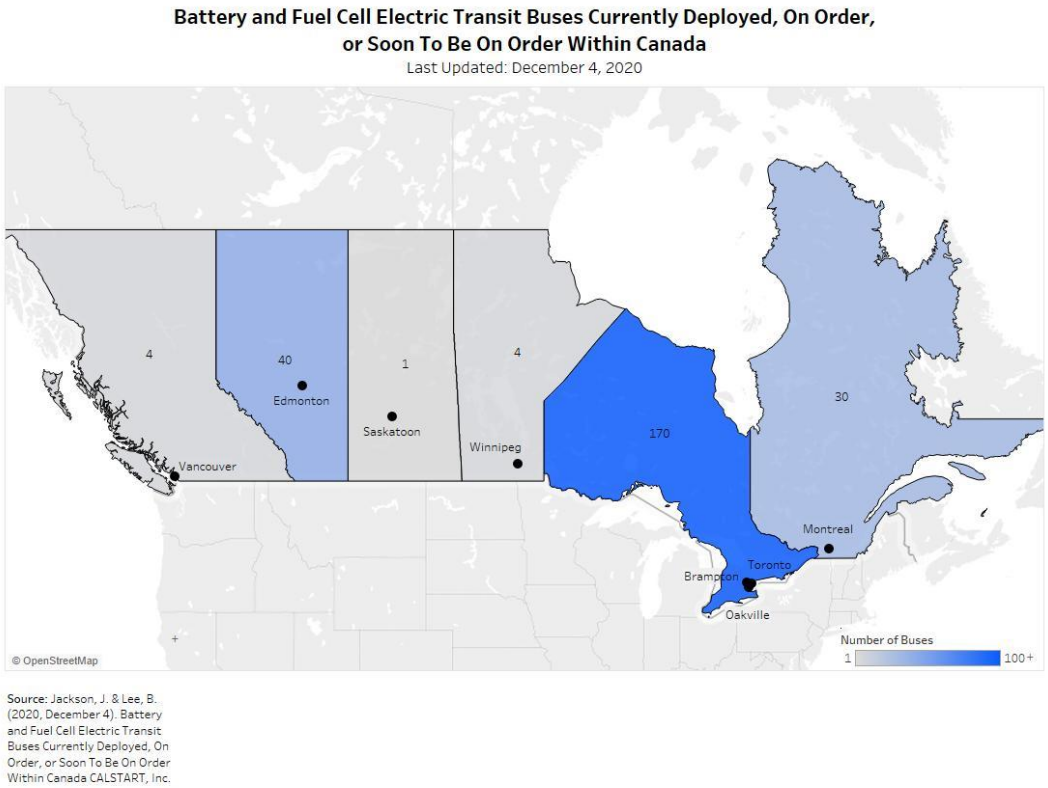



*Figure 17: Zero-Emission Bus Distribution by Canadian Province*

## Section 4: US Small Zero Emission Buses

Zero-emission small buses, defined as battery electric or hydrogen fuel cell cutaway buses with a length of less than 30 feet, a Gross Vehicle Weight Rating (GVWR) of greater than 14,000 pounds, and are classified in the FTA's 5 year/150,000 mile or 7 year/200,000 mile service-life category, have also become an established technology in fleets. While most efforts to electrify fleets has focused on Class 7-8 transit buses, small buses comprise a significant proportion of transit fleets. According to the FTA's 2018 Annual Revenue Vehicle Inventory, transit fleets in the United States employed 183,760 cutaway buses[6]. As a result, small buses are responsible for a large quantity of GHG emissions. Transit agencies typically use small buses to provide demand response service for senior and disabled citizens. However, many transit agencies aim to boast ridership by providing additional services, like on demand response and first/last mile service, to the general public. As a result, the deployment of zero-emission small buses will support the transition to this emerging transit business model. As of December 2020, there are 617 zero-emission small buses purchased, on order, or deployed in the United States. Eighty-three of these small buses have been deployed by transit agencies. However, zero-emission small buses have been deployed by non-transit entities. Private transportation companies, businesses & corporations, and government agencies have also adopted zero-emission buses. Private entities have deployed or purchased 534 zero-emission small buses, all of which are battery electric. One hundred fifty-seven of these private shuttle buses are owned by airport parking companies (see Zero-Emission Airport Buses section). This edition of Zeroing in on ZEBs is the first time that CALSTART has tracked the proliferation of this technology. To gather this data, CALSTART analyzed press releases, data from voucher incentive programs, and cross referenced this data with manufacturers.

To date, battery electric has been the dominant shuttle bus technology, with 608 of the buses being battery electric. There have also been nine fuel cell electric shuttle buses. The majority of zero-emission shuttle bus deployments have occurred in California. However, zero-emission small buses have also been deployed in Nevada, Texas, Iowa, Michigan, Wisconsin, Ohio, and Vermont. Similar to zero-emission transit buses, deployments of zero-emission small buses are primarily concentrated in California, the Midwest, and the Northeast. However, over time, small bus deployments will likely occur in more regions of the United States.

[6] Federal Transit Administration. *2018 Annual Database Revenue Vehicle Inventory.* Available at: https://www.transit.dot.gov/ntd/data-product/2018-annual-database-revenue-vehicle-inventory

## Table 15: U.S. State-By-State Zero-Emission Small Bus Distribution

## Total = 617

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| California | CA | 577 | 4 | 581 |
| Iowa | IA | 2 | 0 | 2 |
| Michigan | MI | 12 | 0 | 12 |
| Nevada | NV | 1 | 0 | 1 |
| Ohio | OH | 0 | 5 | 5 |
| Texas | TX | 6 | 0 | 6 |
| Vermont | VT | 4 | 0 | 4 |
| Wisconsin | WI | 6 | 0 | 6 |
| **Total** | | **608** | **9** | **617** |

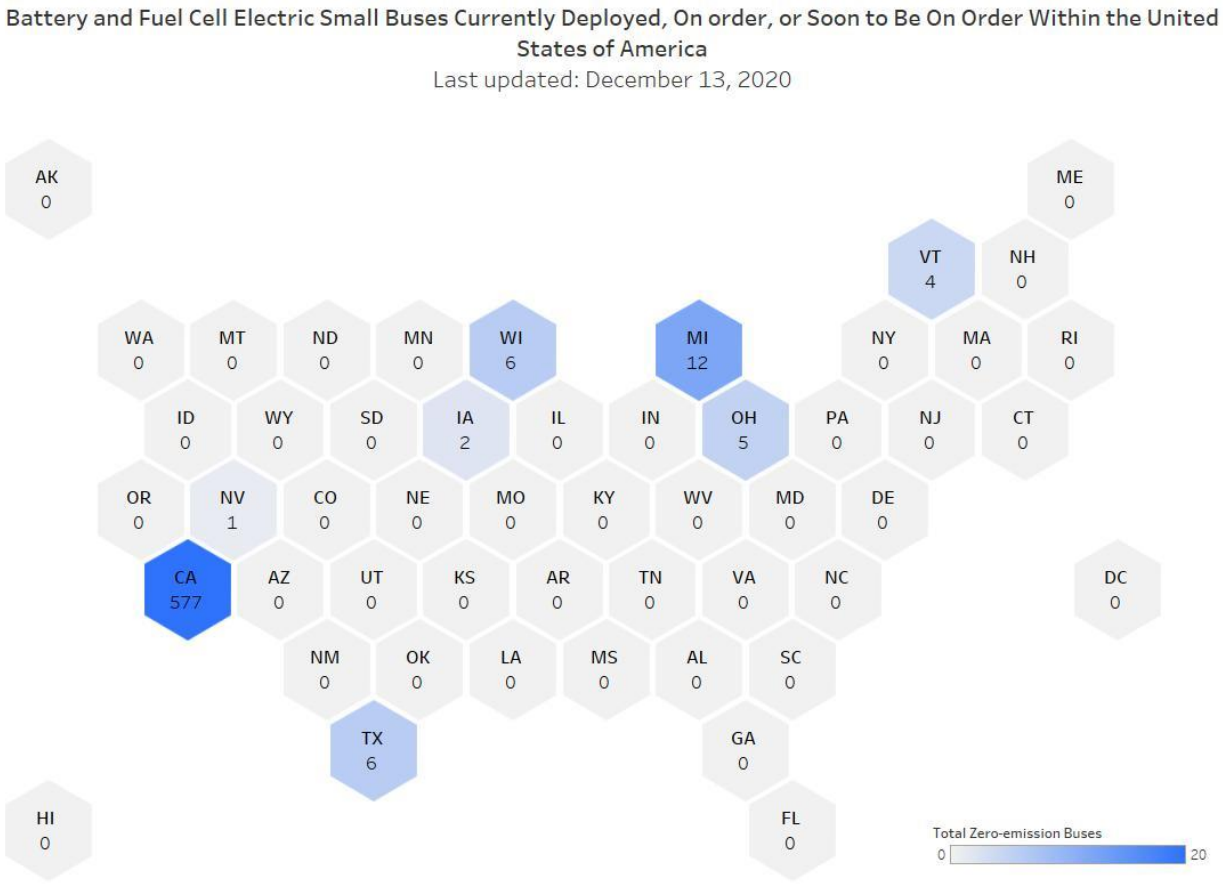



*Figure 18: Zero-Emission Small Bus Distribution by State*

It is important to note that there have been significantly fewer small bus deployments than transit buses. This has occurred because small buses are not as technologically mature as transit buses. While there have been numerous zero-emission transit buses that have completed Altoona testing, the market for small buses that have completed Altoona testing is much smaller. This puts constraints on transit agencies as it means that FTA funding cannot be used to purchase these vehicles. As small buses reach technological maturity and more bus models complete Altoona testing, it is expected that demand for small buses will increase.

Small bus deployments have been supported by various governmental policies. In California, the Innovative Clean Transit Regulation requires that transit agencies begin adopting zero-emission buses in 2023. The percentage of annual bus purchases that must be zero-emission increases over time until 2029, when all bus purchases must be zero-emission. This regulation applies to all buses that have a GVWR of greater than 14,000 pounds. As a result, small buses are subject to the Innovative Clean Transit Regulation, which has incentivized transit agencies to adopt zero-emission buses. As a result, regulatory pressures have driven aggressive deployment of zero-emission small buses in California.

Financial incentive programs have also supported the adoption of zero-emission small buses. California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) is a voucher incentive program that provides funding to purchase zero-emission buses. Numerous small bus purchases have been supported by this program. The Federal Transit Administration's Low-No Emissions Bus Grant Program (LoNo) has also funded zero-emission small bus deployments.

The pace of zero-emission small bus deployments is expected to accelerate. One development that will accelerate deployments is the signing of statewide procurement contracts to small bus manufacturers. These statewide procurement contracts allow transit agencies to purchase buses from manufacturers at a fixed price without having to issue a RFP or initiate the procurement process. These procurement contracts will speed up the purchasing of small buses and will accelerate the growth of this market. At the time of writing, California is able to purchase small buses through the purchasing contract led by the California Association for Coordinated Transportation and the Morongo Basin Transit Authority. Other states may follow suit in the near future, which would help to accelerate deployments.

## Section 5: Zero-Emission Airport Buses

Zero-emission buses have also become a common sight at airports. Numerous airports across the United States have adopted zero-emission transit and small buses. These buses are typically used to as "people movers" to transport flyers from parking lots to their airport terminal. Many companies that operate off-site parking lots have also adopted zero-emission buses to transport flyers to the airport.

To date, airports have deployed or ordered 97 zero-emission transit-style buses. All of these zero-emission airport buses have been battery electric. The majority of airport zero-emission bus deployments have been in California. This growth in airport buses has been driven by California's Zero-emission Airport Shuttle Regulation. This regulation mandates that bus operators in 13 of the state's largest airports must fully transition to zero-emission shuttle buses by 2035[7]. This has led to increased adoption of both zero-emission small and transit buses at airports. This regulation applies to both the airport themselves and private buses that go to the airport. As a result, this regulation has also resulted in private airport parking companies purchasing zero-emission buses. Private airport parking companies have purchased or deployed 157 zero-emission small buses. Due to this regulation, airports and private airport parking companies in California are expected to deploy additional zero-emission buses in the future.

### Table 16: Zero-Emission Airport Buses State-By-State Distribution

### Total = 97

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| California | CA | 51 | 0 | 51 |
| Georgia | GA | 2 | 0 | 2 |
| Indiana | IN | 9 | 0 | 9 |
| Michigan | MI | 2 | 0 | 2 |
| Missouri | MO | 4 | 0 | 4 |
| New Jersey | NJ | 6 | 0 | 6 |
| New Mexico | NM | 2 | 0 | 2 |

[7] California Air Resources Board. (2019, June 19). Retrieved December 08, 2020, from https://ww2.arb.ca.gov/news/california-air-resources-board-approves-comprehensive-effort-clean-airport-shuttles

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| New York | NY | 12 | 0 | 12 |
| North Carolina | NC | 9 | 0 | 9 |
| **Total** | | **97** | **0** | **97** |

## Table 17: Airports with Battery Electric or Fuel Cell Buses

| # | State | Airport |
|---|---|---|
| 1. | CA | John Wayne Airport (SNA) |
| 2. | CA | Los Angeles International Airport (LAX) |
| 3. | CA | Sacramento International Airport (SMF) |
| 4. | CA | San Diego International Airport (SAN) |
| 5. | CA | San Francisco Airport Commission – San Francisco International Airport (SFO) |
| 6. | CA | San Jose Norman Mineta International Airport (SJC) |
| 7. | GA | Hartsfield-Jackson Atlanta International Airport (ATL) |
| 8. | IN | Indianapolis International Airport (IND) |
| 9. | MI | Detroit Metropolitan Airport (DTW) |
| 10. | MO | Kansas City International Airport (MCI) |
| 11. | NC | Charlotte Douglas International Airport (CLT) |
| 12. | NC | Raleigh-Durham International Airport (RDU) |
| 13. | NJ | Newark Liberty International Airport (EWR) |
| 14. | NM | Albuquerque Sunport International Airport (ABQ) |
| 15. | NY | John F. Kennedy International Airport (JFK) |
| 16. | NY | New York LaGuardia International Airport (LGA) |

## Section 6: Utility and Grid Impacts

The deployment of zero-emission buses will have implications for the electrical grid. Zero-emission buses, regardless of the fuel type, are energy intensive and require electricity to operate. Battery electric buses consume electricity directly as fuel. Fuel cell electric buses on the other hand, consume hydrogen. However, electricity is used to produce, compress, and dispense hydrogen to the buses. As a result, the deployment of zero-emission buses will increase the amount of electricity that transit agencies consume. The nation-wide power demand from the 2,790 zero-emission transit buses in this report is expected to be 143.46 MW. If California's ICT Regulation is fully implemented, California, by itself, would have 12,000 ZEBs deployed by 2030.[8] These deployments are expected to draw 617.14 MW. If all of America's 65,000 transit buses are electrified, this would draw 3,342.85 MW. In 2019, average power draw for the United States was 471,105.25 MW.[9] The United States has 1.1 million MW of utility-scale electrical generation capacity.[10] As a result, the United States has enough generation to power these buses. However, the main challenge will be to ensure that localities and each transit agency has access to this power capacity.

The amount of power that a fleet draws from the grid depends on the size of the fleet. The average battery electric bus is expected to have a power demand of approximately 51 kW, assuming a 7-hour charging time. Table 18 below outlines the expected power demand for various fleet sizes of battery electric buses:

### Table 18: BEB Fleet Power Demand

| Electric | | | | |
|---|---|---|---|---|
| Fleet Size | kWh/bus | utilized capacity | Time to charge (hours) | Peak in MW |
| 50 | 450 | 80% | 7 | 2.57 |
| 100 | 450 | 80% | 7 | 5.14 |
| 250 | 450 | 80% | 7 | 12.86 |

[8] American Public Transportation Association. (2019). "Public Transit Leading in Transition to Clean Technology." Available at: https://www.apta.com/wp-content/uploads/Public_Transit_Leading_In_Transition_To_Clean_Technology.pdf

[9] US Energy Information Administration. "Total Electric Power Industry Summary Statistics, 2019 and 2018." Available at: https://www.eia.gov/electricity/annual/html/epa_01_01.html

[10] US Energy Information Administration. "Electricity explained: Electricity generation, capacity, and sales in the United States." Available at: https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php#:~:text=At%20the%20end%20of%202019,solar%20photovoltaic%20electricity%20generating%20capacity.

The power demand for a fuel cell electric bus fleet mainly comes from the compression and dispensing of hydrogen to the buses. Table 19: FCEB Fleet Power Demand outlines the expected power demand for various sizes of fuel cell electric bus fleets:

## Table 19: FCEB Fleet Power Demand

| Hydrogen | | | | |
|---|---|---|---|---|
| Number of buses | kg/day | kWh/kg for Compression* | time available to compress and fill | Peak MW |
| 50 | 30 | 3.1 | 7 | 0.66 |
| 100 | 30 | 3.1 | 7 | 1.33 |
| 250 | 30 | 3.1 | 7 | 3.32 |

Figure 19 compares the power demand between BEB and FCEB fleets for various fleet sizes. BEB fleets draw much more power than FCEB fleets and as a result, have more impact on the grid.

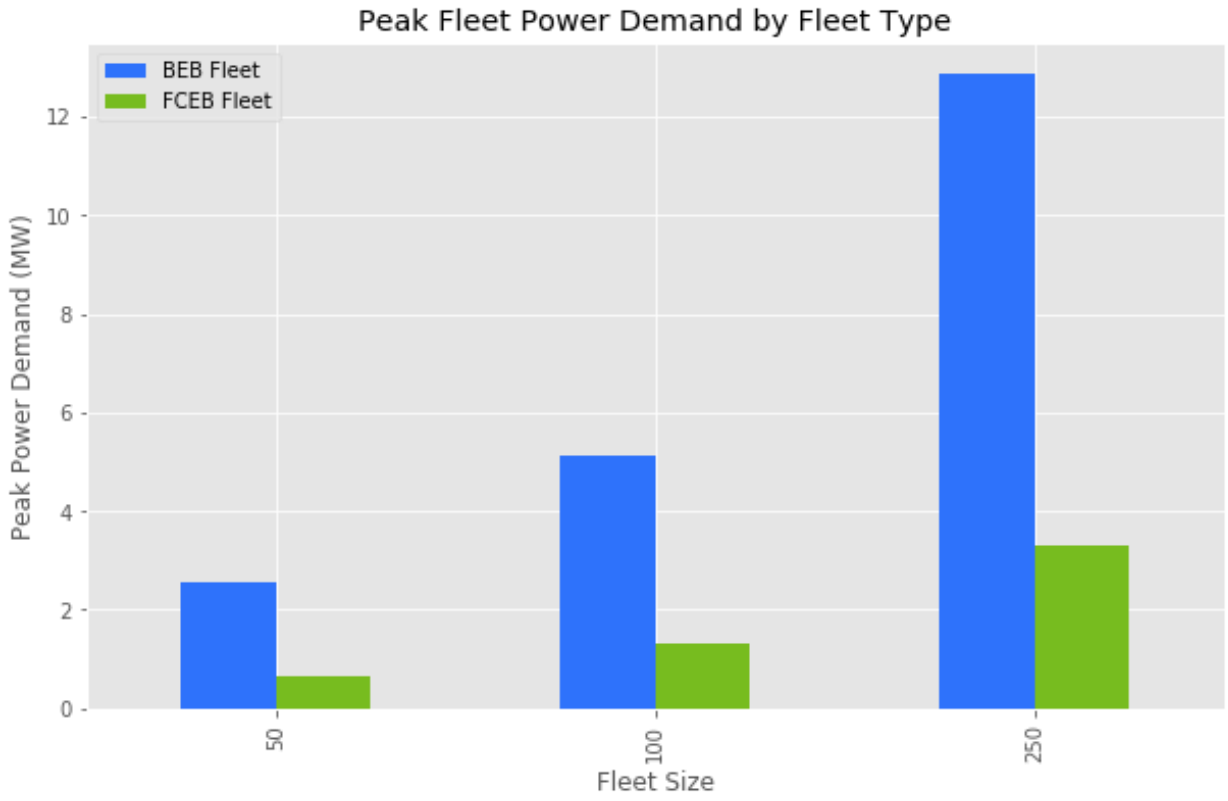



*Figure 19: Peak Fleet Power Demand*

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# Appendix A: Transit Properties with Battery Electric or Fuel Cell Transit Buses

## Total # of Transit Agencies = 229

The following chart lists all of the transit agencies in the United States have deployed or purchased ZEBs. Transit agencies that have ordered ZEBs but are not yet in physical possession of them are included in this chart.

| # | State | Transit Agency |
|---|---|---|
| 1. | AL | Alabama A&M University |
| 2. | AL | Birmingham-Jefferson County Transit Authority (BJCTA MAX) |
| 3. | AK | Alaska Department of Transportation & Public Facilities |
| 4. | AK | City and Borough or Juneau (Capital Transit) |
| 5. | AZ | City of Tucson (SunTran) |
| 6. | CA | Airline Coach Services |
| 7. | CA | Alameda-Contra Costa Transit District (AC Transit) |
| 8. | CA | Anaheim Resort Transportation |
| 9. | CA | Anteater Express (University of California, Irvine) |
| 10. | CA | Arvin Transit |
| 11. | CA | Antelope Valley Transit Authority (AVTA) |
| 12. | CA | Big Blue Bus |
| 13. | CA | Bruin Bus (University of California, Los Angeles) |
| 14. | CA | Butte Regional Transit (BCAG) |
| 15. | CA | California State University Fresno |
| 16. | CA | Central Contra Costa Transit Authority (CCTA / County Connection) |
| 17. | CA | City of San Jose |
| 18. | CA | Culver City Bus |
| 19. | CA | Fairfield and Suisun Transit (FAST) |
| 20. | CA | Foothill Transit |
| 21. | CA | Fresno Area Express (FAX) |
| 22. | CA | Fresno County Rural Transit |
| 23. | CA | Golden Empire Transit District (GETbus) |
| 24. | CA | Gardena Transit (GTrans) |
| 25. | CA | Humboldt Transit Authority |
| 26. | CA | Lake Transit Authority |
| 27. | CA | Los Angeles County Metropolitan Transportation Authority (LA Metro) |
| 28. | CA | Los Angeles Department of Transportation (LADOT) |
| 29. | CA | Long Beach Transit |
| 30. | CA | Marguerite (Stanford University) |

| # | State | Transit Agency |
|---|---|---|
| 31. | CA | Marin Transit |
| 32. | CA | Merced County (TJPAMC) |
| 33. | CA | Modesto Transit |
| 34. | CA | Montebello Transit |
| 35. | CA | Monterey-Salinas Transit |
| 36. | CA | Napa Valley Transportation Authority |
| 37. | CA | North County Transit District |
| 38. | CA | Norwalk Transit System |
| 39. | CA | Orange County Transportation Authority (OCTA) |
| 40. | CA | Porterville Transit |
| 41. | CA | Redding Area Bus Authority |
| 42. | CA | Roseville Transit |
| 43. | CA | Sacramento Regional Transit District (SacRTD and Yolo County Transit – Yolo Bus) |
| 44. | CA | San Diego Metropolitan Transit System (San Diego MTS) |
| 45. | CA | San Francisco Municipal Transportation Agency (SF Muni) |
| 46. | CA | San Joaquin Regional Transit District (SJRTD) |
| 47. | CA | San Mateo County Transit District (SamTrans) |
| 48. | CA | Santa Barbara Metropolitan Transit District (SBMTD) |
| 49. | CA | Santa Clara Valley Transportation Authority (Santa Clara VTA) |
| 50. | CA | Santa Cruz Metropolitan Transit Districts |
| 51. | CA | Santa Monica Big Blue Bus (BBB) |
| 52. | CA | Santa Rosa City Bus |
| 53. | CA | Solano County Transit |
| 54. | CA | Sonoma County Transit |
| 55. | CA | SunLine Transit |
| 56. | CA | Tri Delta Transit (Antioch Transit/Eastern Contra Costa Transit Authority) |
| 57. | CA | Unitrans (UC Davis) |
| 58. | CA | University of California, Irvine (UCI) |
| 59. | CA | University of California, San Francisco (UCSF) |
| 60. | CA | Victor Valley Transit Authority |
| 61. | CA | Yosemite National Park |
| 62. | CA | Visalia Transit |
| 63. | CO | Avon Transit |
| 64. | CO | City of Boulder (GoBoulder) |
| 65. | CO | City of Colorado Springs (Mountain Metro Transit) |
| 66. | CO | Eagle County Transit (ECO Transit) |
| 67. | CO | Estes Park Transit |
| 68. | CO | City of Fort Collins (Transfort) |

| # | State | Transit Agency |
|---|---|---|
| 69. | CO | Denver Regional Transportation District (RTD) |
| 70. | CO | Roaring Fork Transportation Authority (RFTA) |
| 71. | CO | State of Colorado Department of Transportation |
| 72. | CO | Summit Stage (Summit County) |
| 73. | CO | Town of Breckenridge |
| 74. | CO | Town of Vail |
| 75. | CO | Via Transit |
| 76. | CT | Connecticut Department of Transportation |
| 77. | CT | Windham Regional Transit District |
| 78. | CT | Greater Bridgeport Transit (GBT) |
| 79. | CT | Yale University |
| 80. | DC | Washington Metropolitan Area Transportation Authority and District Transportation Authority (WMATA and DCDOT) |
| 81. | DE | Delaware Transit Corporation |
| 82. | FL | Broward County |
| 83. | FL | Star Metro - City of Tallahassee |
| 84. | FL | Gainesville RTS |
| 85. | FL | Hillsborough Area Regional Transit Authority (HART) |
| 86. | FL | Jacksonville Transportation Authority |
| 87. | FL | Central Florida Regional Transportation Authority (LYNX) |
| 88. | FL | Miami-Dade County Transit |
| 89. | FL | Pinellas Suncoast Transit Authority |
| 90. | GA | Chatham Area Transit Authority |
| 91. | GA | Macon – Bibb County Transit Authority - Georgia Department of Transportation |
| 92. | GA | Metropolitan Atlanta Rapid Transit Authority (MARTA) |
| 93. | GA | University of Georgia (UGA) |
| 94. | HI | County of Hawaii (Hele-On) |
| 95. | HI | City and County of Honolulu |
| 96. | HI | State of Hawaii Department of Transportation |
| 97. | IA | Iowa State University (CyRide) |
| 98. | IA | Des Moines Area Regional Transit Authority (DART) |
| 99. | IA | Iowa City Transit |
| 100. | ID | Mountain Rides Transit Authority |
| 101. | ID | Valley Regional Transit |
| 102. | IL | Bloomington-Normal Public Transit System |
| 103. | IL | Champaign-Urbana Mass Transit |
| 104. | IL | Chicago Transit Authority (CTA) |
| 105. | IL | Greater Peoria Mass Transit District |
| 106. | IL | JLL |

| # | State | Transit Agency |
|---|---|---|
| 107. | IL | Quad Cities Metrolink |
| 108. | IN | Fort Wayne Public Transit |
| 109. | IN | Gary Public Transit Corporation |
| 110. | IN | Bloomington Public Transportation Corporation |
| 111. | IN | Indianapolis Public Transportation Authority - IndyGo |
| 112. | KS | City of Wichita (Wichita Transit) |
| 113. | KS | Lawrence Transit |
| 114. | KY | City of Owensboro (Owensboro Transit) |
| 115. | KY | Lextrans |
| 116. | KY | Transit Authority of River City (TARC) |
| 117. | MA | Martha's Vineyard Transit Authority |
| 118. | MA | Massachusetts Bay Transportation Authority (MBTA) |
| 119. | MA | MetroWest Regional Transit Authority (MWRTA) |
| 120. | MA | Pioneer Valley Transit Authority |
| 121. | MA | Worcester Regional Transit Authority |
| 122. | MD | Maryland Department of Transportation |
| 123. | MD | Montgomery County, Maryland |
| 124. | MD | Prince George's County |
| 125. | MD | Regional Transportation Agency |
| 126. | MD | TransIT (Frederick County) |
| 127. | MI | Blue Water Area Transportation Commission |
| 128. | MI | Capital Area Transit Authority |
| 129. | MI | Flint Mass Transportation Authority |
| 130. | MI | Detroit Department of Transportation/SMART |
| 131. | MI | Huron Transit |
| 132. | MI | Michigan Department of Transportation (Benzie Transit) |
| 133. | MN | City of Rochester |
| 134. | MN | Duluth Transit Authority |
| 135. | MN | Metro Transit |
| 136. | MO | City of Columbia |
| 137. | MO | St Louis Metro Transit |
| 138. | MS | Coast Transit Authority |
| 139. | MT | Missoula Urban Transportation District |
| 140. | MT | University of Montana |
| 141. | NC | Chapel Hill Transit |
| 142. | NC | Charlotte Area Transit System |
| 143. | NC | City of Asheville |
| 144. | NC | City of Durham |
| 145. | NC | Duke University |
| 146. | NC | Greensboro Transit Authority |

| # | State | Transit Agency |
|---|---|---|
| 147. | NC | GoRaleigh |
| 148. | NC | Research Triangle Regional Public Transportation Authority (GoTriangle) |
| 149. | NE | City of Lincoln (StarTran) |
| 150. | NE | Omaha Metro |
| 151. | NJ | Academy Express LLC |
| 152. | NJ | New Jersey Transit |
| 153. | NM | Atomic City Transit |
| 154. | NM | Albuquerque Rapid Transit |
| 155. | NM | ABQ Ride |
| 156. | NM | City of Las Cruces |
| 157. | NM | North Central Regional Transit District |
| 158. | NV | Regional Transportation of Washoe County |
| 159. | NV | Tahoe Transportation District |
| 160. | NV | Washoe Regional Transportation District |
| 161. | NY | Capital District Transportation Authority |
| 162. | NY | Columbia University |
| 163. | NY | Niagara Frontier Transportation Authority |
| 164. | NY | New York City Metropolitan Transit Authority (MTA) |
| 165. | NY | Port Authority of NY and NJ |
| 166. | NY | Rochester Genesee Regional Transportation Authority |
| 167. | NY | Suffolk County Transit |
| 168. | NY | Tompkins Consolidated Area Transit |
| 169. | NY | Westchester County Department of Transportation |
| 170. | OH | Central Ohio Transit Authority (COTA) |
| 171. | OH | Metro RTA |
| 172. | OH | Laketran |
| 173. | OH | Stark Area Regional Transit Authority (SARTA) |
| 174. | OH | Toledo Area Rapid Transit (TARTA) |
| 175. | OK | Central Oklahoma Transportation and Parking Authority (Embark) |
| 176. | OK | Cherokee Nation |
| 177. | OR | City of Wilsonville, Oregon |
| 178. | OR | Lane Transit District (LTD) |
| 179. | OR | Salem Mass Transit District |
| 180. | OR | TriMet |
| 181. | PA | Berks Area Regional Transit Authority (BARTA) |
| 182. | PA | Port Authority of Allegheny County (PAAC) |
| 183. | PA | Southeastern Pennsylvania Transportation Authority (SEPTA) |
| 184. | RI | Rhode Island Public Transit Authority |
| 185. | SC | Berkeley-Charleston Dorchester Council of Government |

| # | State | Transit Agency |
|---|---|---|
| 186. | SC | Charleston Area Regional Transportation Authority |
| 187. | SC | City of Rock Hill |
| 188. | SC | City of Seneca and Oconee County |
| 189. | SC | Clemson Area Transit |
| 190. | SC | Greenville Transit Authority (GreenLink) |
| 191. | TN | Chattanooga Area Regional Transportation Authority |
| 192. | TN | Memphis Area Transit |
| 193. | TN | Nashville Metropolitan Transit Authority (Nashville MTA) |
| 194. | TX | Capital Metropolitan Transportation Authority |
| 195. | TX | City of Lubbock/Citibus |
| 196. | TX | City of McAllen |
| 197. | TX | Dallas Area Rapid Transit Authority (DART) |
| 198. | TX | Port Arthur Transit |
| 199. | TX | VIA Metropolitan Transit |
| 200. | UT | Park City Transit |
| 201. | UT | Utah Transit Authority (UTA) |
| 202. | VA | Alexandria (DASH) |
| 203. | VA | Blacksburg Transit |
| 204. | VA | Hampton Roads Transit |
| 205. | VT | Green Mountain Transit |
| 206. | VT | Marble Valley Regional Transit District (VEIC) |
| 207. | VT | Vermont Agency of Transportation |
| 208. | WA | Ben Franklin Transit (BFT) |
| 209. | WA | Chelan Douglas Public Transportation Benefit Area |
| 210. | WA | Clark County Public Transit Benefit Area Authority (C-Tran) |
| 211. | WA | Everett Transit |
| 212. | WA | Grant Transit Authority |
| 213. | WA | King County Metro |
| 214. | WA | Kitsap Transit |
| 215. | WA | Link Transit |
| 216. | WA | Metro Transit |
| 217. | WA | Pierce Transit |
| 218. | WA | Spokane Transit (STA) |
| 219. | WA | Valley Transit |
| 220. | WA | Whatcom Transportation Authority |
| 221. | WI | City of Madison |
| 222. | WI | City of La Crosse |
| 223. | WI | City of Merrill |
| 224. | WI | Dunn County Transit |
| 225. | WI | Milwaukee County Department of Transportation |

| # | State | Transit Agency |
|---|---|---|
| 226. | WI | Wisconsin Department of Transportation (WDOT) |
| 227. | WI | City of Racine (Racine Transit) |
| 228. | WY | Southern Teton Area Rapid Transit |
| 229. | GU | Guam Regional Transit Authority |

# Appendix B: State-by-State Active U.S. Zero-Emissions Transit Buses

## Total = 1016[11]

The following chart provides a state-by-state breakdown of the number of active zero-emission transit buses. Active buses are those that have been delivered and are in the physical possession of the transit agency.

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Alabama | AL | 0 | 0 | 0 |
| Alaska | AK | 0 | 0 | 0 |
| Arizona | AZ | 0 | 0 | 0 |
| Arkansas | AR | 0 | 0 | 0 |
| California | CA | 452 | 72 | 524 |
| Colorado | CO | 44 | 0 | 44 |
| Connecticut | CT | 12 | 0 | 12 |
| Delaware | DE | 0 | 0 | 0 |
| District of Columbia | DC | 15 | 0 | 15 |
| Florida | FL | 31 | 0 | 31 |
| Georgia | GA | 2 | 0 | 2 |
| Hawaii | HI | 0 | 0 | 0 |
| Idaho | ID | 0 | 0 | 0 |
| Illinois | IL | 40 | 2 | 42 |
| Indiana | IN | 21 | 0 | 21 |
| Iowa | IA | 0 | 0 | 0 |
| Kansas | KS | 0 | 0 | 0 |
| Kentucky | KY | 21 | 0 | 21 |
| Louisiana | LA | 0 | 0 | 0 |
| Maine | ME | 0 | 0 | 0 |
| Maryland | MD | 4 | 0 | 4 |
| Massachusetts | MA | 0 | 0 | 0 |
| Michigan | MI | 0 | 2 | 2 |
| Minnesota | MN | 16 | 0 | 16 |
| Mississippi | MS | 0 | 0 | 0 |
| Missouri | MO | 18 | 0 | 18 |
| Montana | MT | 8 | 0 | 8 |

[11] This number is derived from a combination of data from the 2020 APTA Fact Book, CALSTART internal tracking of ZEBs since 2016, and total HVIP Vouchers redeemed

| State | | Battery Electric Buses | Fuel Cell Buses | Total Zero-emission Buses |
|---|---|---|---|---|
| Nebraska | NE | 0 | 0 | 0 |
| Nevada | NV | 21 | 0 | 21 |
| New Hampshire | NH | 0 | 0 | 0 |
| New Jersey | NJ | 0 | 0 | 0 |
| New Mexico | NM | 18 | 0 | 18 |
| New York | NY | 29 | 0 | 29 |
| North Carolina | NC | 23 | 0 | 23 |
| North Dakota | ND | 0 | 0 | 0 |
| Ohio | OH | 0 | 7 | 7 |
| Oklahoma | OK | 1 | 0 | 1 |
| Oregon | OR | 5 | 0 | 5 |
| Pennsylvania | PA | 29 | 0 | 29 |
| Rhode Island | RI | 0 | 0 | 0 |
| South Carolina | SC | 14 | 0 | 14 |
| South Dakota | SD | 0 | 0 | 0 |
| Tennessee | TN | 32 | 0 | 32 |
| Texas | TX | 22 | 0 | 22 |
| Utah | UT | 3 | 0 | 3 |
| Vermont | VT | 0 | 0 | 0 |
| Virginia | VA | 5 | 0 | 5 |
| Washington | WA | 47 | 0 | 47 |
| West Virginia | WV | 0 | 0 | 0 |
| Wisconsin | WI | 0 | 0 | 0 |
| Wyoming | WY | 0 | 0 | 0 |
| **Total** | | **933** | **83** | **1016** |

# Appendix C: Transit Properties with Active Battery Electric or Fuel Cell Transit Buses

The following chart lists the transit agencies that have active ZEB deployments.

| # | State | Transit Agency |
|---|---|---|
| 1. | CA | Alameda-Contra Costa Transit District (AC Transit) |
| 2. | CA | Anaheim Resort Transportation |
| 3. | CA | Antelope Valley Transit Authority (AVTA) |
| 4. | CA | Central Contra Costa Transit Authority (CCTA / County Connection) |
| 5. | CA | Culver City Bus |
| 6. | CA | Foothill Transit |
| 7. | CA | Golden Empire Transit District (GETbus) |
| 8. | CA | Gardena Transit (GTrans) |
| 9. | CA | Los Angeles County Metropolitan Transportation Authority (LA Metro) |
| 10. | CA | Long Beach Transit |
| 11. | CA | Montebello Transit |
| 12. | CA | Monterey-Salinas Transit |
| 13. | CA | Orange County Transportation Authority (OCTA) |
| 14. | CA | Sacramento Regional Transit District (SacRTD and Yolo County Transit – Yolo Bus) |
| 15. | CA | San Diego Metropolitan Transit System (San Diego MTS) |
| 16. | CA | San Francisco Municipal Transportation Agency (SF Muni) |
| 17. | CA | San Joaquin Regional Transit District |
| 18. | CA | Santa Barbara Metropolitan Transit District |
| 19. | CA | Santa Clara Valley Transportation Authority (VTA) |
| 20. | CA | Santa Cruz Metropolitan Transit Districts |
| 21. | CA | Solano County Transit |
| 22. | CA | SunLine Transit |
| 23. | CA | Tri Delta Transit (Antioch Transit/Eastern Contra Costa Transit Authority) |
| 24. | CA | Victor Valley Transit Authority |
| 25. | CA | Yosemite National Park |
| 26. | CA | Visalia Transit |
| 27. | CA | We Drive U, Inc. |
| 28. | CO | Denver RTD |
| 29. | CO | Roaring Fork Transportation Authority (RFTA) |

| # | State | Transit Agency |
|---|---|---|
| 30. | CT | CTtransit - Connecticut Department of Transportation |
| 31. | DC | DC Circulator |
| 32. | DE | Delaware Transit Corporation |
| 33. | FL | Broward County |
| 34. | FL | Star Metro - City of Tallahassee |
| 35. | FL | Gainesville RTS |
| 36. | FL | Hillsborough Area Regional Transit Authority (HART) |
| 37. | FL | Jacksonville Transportation Authority |
| 38. | FL | Central Florida Regional Transportation Authority (LYNX) |
| 39. | FL | Miami-Dade County Transit |
| 40. | FL | Pinellas Suncoast Transit Authority |
| 41. | FL | StarMetro – City of Tallahassee |
| 42. | GA | Chatham Area Transit Authority |
| 43. | GA | Georgia Department of Transportation |
| 44. | GA | Metropolitan Atlanta Rapid Transit Authority (MARTA) |
| 45. | GA | University of Georgia |
| 46. | HI | County of Hawaii (Hele-On) |
| 47. | HI | City and County of Honolulu |
| 48. | HI | Daniel K. Inouye International Airport |
| 49. | HI | JTB Hawaii |
| 50. | HI | State of Hawaii Department of Transportation |
| 51. | IA | CyRide - Iowa State University |
| 52. | IA | Des Moines Area Regional Transit Authority (DART) |
| 53. | ID | Mountain Rides Transportation Authority |
| 54. | ID | Valley Regional Transit |
| 55. | IL | 601 W Companies, LLC |
| 56. | IL | Bloomington-Normal Public Transit System |
| 57. | IL | Champaign-Urbana Mass Transit |
| 58. | IL | Chicago Transit Authority |
| 59. | IL | Greater Peoria Mass Transit District |
| 60. | IL | JLL |
| 61. | IL | Quad Cities Metrolink |
| 62. | IL | SL PRU, LLC |
| 63. | IN | Bloomington Public Transportation Corporation |
| 64. | IN | Indianapolis Airport |
| 65. | IN | IndyGo |
| 66. | KS | City of Wichita (Wichita Transit) |
| 67. | KS | Lawrence Transit |
| 68. | KS | Topeka Metro |

| # | State | Transit Agency |
|---|---|---|
| 69. | KY | City of Owensboro (Owensboro Transit) |
| 70. | KY | Lextrans |
| 71. | KY | Transit Authority of River City (TARC) |
| 72. | LA | Capital Area Transit Systems (CATS) |
| 73. | LA | City of Shreveport |
| 74. | LA | Lafayette City-Parish Consolidated Government |
| 75. | MA | Martha's Vineyard Transit Authority |
| 76. | MA | Massachusetts Bay Transportation Authority (MBTA) |
| 77. | MA | MetroWest Regional Transit Authority (MWRTA) |
| 78. | MA | Pioneer Valley Transit Authority |
| 79. | MA | Worcester Regional Transit Authority |
| 80. | MD | Maryland Department of Transportation |
| 81. | MD | Montgomery County, Maryland |
| 82. | MD | Prince George's County |
| 83. | MD | Regional Transportation Agency |
| 84. | MD | TransIT (Frederick County) |
| 85. | MI | Capital Area Transit Authority (CATS) |
| 86. | MI | Blue Water Area Transportation Commission |
| 87. | MI | Detroit Department of Transportation/SMART |
| 88. | MI | Flint Mass Transportation Authority |
| 89. | MN | City of Rochester |
| 90. | MN | Duluth Transit Authority |
| 91. | MN | Metro Transit |
| 92. | MO | St Louis Metro Transit |
| 93. | MT | Missoula Urban Transportation District |
| 94. | MT | University of Montana |
| 95. | NC | Greensboro Transit Authority |
| 96. | NC | Raleigh-Durham International Airport |
| 97. | NC | GoRaleigh |
| 98. | NC | Research Triangle Regional Public Transportation Authority (GoTriangle) |
| 99. | NJ | Academy Express LLC |
| 100. | NJ | New Jersey Transit (NJ Transit) |
| 101. | NM | ABQ Ride |
| 102. | NV | Washoe Regional Transportation District |
| 103. | NY | Capital District Transportation Authority |
| 104. | NY | New York City Metropolitan Transit Authority (MTA) |
| 105. | NY | Rochester Genesee Regional Transportation Authority |
| 106. | OH | Stark Area Regional Transit Authority (SARTA) |

| # | State | Transit Agency |
|---|---|---|
| 107. | OK | Central Oklahoma Transportation and Parking Authority (Embark) |
| 108. | OR | TriMet |
| 109. | PA | Port Authority of Allegheny County (PAAC) |
| 110. | PA | Southeastern Pennsylvania Transportation Authority (SEPTA) |
| 111. | SC | Clemson Area Transit |
| 112. | SC | Greenville Transit Authority |
| 113. | TN | Metropolitan Transit Authority |
| 114. | TX | Capital Metropolitan Transportation Authority |
| 115. | TX | Dallas Area Rapid Transit Authority (DART) |
| 116. | TX | VIA Metropolitan Transit |
| 117. | UT | Utah Transit Authority (UTA) |
| 118. | VA | Blacksburg Transit |
| 119. | WA | Chelan Douglas Public Transportation Benefit Area |
| 120. | WA | King County Metro |
| 121. | WA | Kitsap Transit |
| 122. | WA | Pierce Transit |