

ZEROING IN ON ZEBs

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

December 2021

A CALSTART Report
By Hannah Hamilton, Rachel Chard,
Bryan Lee, Fred Silver, and Justin Slosky
www.calstart.org



Acknowledgments

This report was funded by the Federal Transit Administration (FTA) and the California Air Resources Board (CARB) Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). The authors would like to thank key CALSTART staff for their critical review of and additions to this report, including Emily Varnell, Lily Paul, Juan Espinoza, and Narayan Gopinathan, as well as the Canadian Urban Transit Research & Innovation Consortium (CUTRIC) for working with CALSTART to confirm bus counts for Canada. Any errors are the authors' own.

No part of this document may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission by CALSTART. Requests for permission or further information should be addressed to CALSTART, 48 S. Chester Ave, Pasadena, CA 91106 or Publications@CALSTART.org. This document is based on information gathered as of September 2021.

All rights reserved.

CALSTART
www.CALSTART.org
[@CALSTART](https://twitter.com/CALSTART)

© Copyright 2021 CALSTART

Correction notice: There were two errors in Table 1. In the first row under “Increase ('20 to '21)” the figure was incorrectly listed as 643. In the third row under “Increase ('20 to '21)” the figure was incorrectly listed as 725.



Table of Contents

Acknowledgments	ii
List of Acronyms	iv
Figures and Tables	v
Executive Summary	1
I. Introduction and Background.....	2
II. U.S. Full-Size Transit ZEB Count	5
Fuel Cell Electric Buses (FCEBs)	12
III. U.S. Small ZEBs	13
IV. Airport ZEBs	16
V. Canadian ZEBs	18
VI. U.S. Policy and Funding Sources.....	20
VII. Canadian Policy and Funding Sources	22
References.....	24
Appendix A: State-by-State Active U.S. Zero-Emission Transit Buses	25
Appendix B: Regional Breakdown of ZEB Distribution by FTA Region	27



List of Acronyms

BEB	Battery-Electric Bus
BEV	Battery-Electric Vehicle
CAA	Clean Air Act
CARB	California Air Resources Board
CIB	Canadian Infrastructure Bank
CMAQ	Congestion Mitigation and Air Quality Improvement
CUTRIC	Canadian Urban Transit Research & Innovation Consortium
EVID	Electric Vehicle Infrastructure Development
FCEB	Fuel Cell Electric Bus
FCEV	Fuel Cell Electric Vehicle
FTA	Federal Transit Administration
GVWR	Gross Vehicle Weight Rating
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICT	Innovative Clean Transit
IJA	Infrastructure Investment and Jobs Act
NYSERDA	New York State Energy Research and Development Authority
NYTVIP	New York Truck Voucher Incentive Program
TIRCP	Transit and Intercity Rail Capital Program
ZEB	Zero-Emission Bus



Figures and Tables

Figures

Figure 1: The Zero-Emission Beachhead (CARB, 2021)

Figure 2: Full-Size Transit Zero-Emission Buses Funded, Ordered, Delivered, or Deployed Within the United States (Updated September 2021)

Figure 3: Total Full-Size Zero-Emission Buses Deployed by FTA Region (Updated September 2021)

Figure 4: Top 10 States Increase in Full-Size Transit Zero-Emission Buses Compared to 2020

Figure 5: Distribution of Full-Size Zero-Emission Bus Fleet Size in the United States

Tables

Table 1: U.S. Full-Size Transit Zero-Emission Buses Year-Over-Year Growth

Table 2: State-By-State Full-Size Transit Zero-Emission Bus Distribution (Updated September 2021)

Table 3: Fuel Cell Electric Buses with State Breakdown and U.S. Total, Year-Over-Year

Table 4: U.S. Small Zero-Emission Buses Year-Over-Year Growth

Table 5: State-By-State Small Zero-Emission Bus Distribution (Updated September 2021)

Table 6: Airport Zero-Emission Buses State-By-State Distribution (Updated September 2021)

Table 7: Transit Zero-Emission Buses by Canadian Province (Updated September 2021)

Table A-1: State-by-State Full-Size Zero-Emission Buses Deployed in the United States

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

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

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

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

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

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

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

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

Table B-9: FTA Region 9 (Without California) State-By-State Zero-Emission Bus Distribution

Table B-10: FTA California (Region 9) State-By-State Zero-Emission Bus Distribution

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

Executive Summary

This report aims to provide an updated inventory of the number of zero-emission buses (ZEBs) currently adopted within the United States and Canada, according to data collected through September 2021. The adoption of ZEBs increased steadily in the past year, as transit operators continued to take advantage of advances in zero-emission technology and available funding sources. In the United States, the count of full-size ZEBs grew to 3,533 ZEBs, representing 27% growth since the 2020 count. In Canada, the total number of ZEBs grew to 606, including 307 new full-size ZEBs counted this year.

In the United States, the count of full-size zero-emission buses (ZEBs) has grown to more than 3,533 buses, representing 27% growth since the 2020 count.

California continues to be the state with the most ZEBs adopted. However, other states significantly added to their adoption of ZEBs, such as New York, which increased its orders of full-size ZEBs from 77 total in 2020 to 195 in 2021. Most fleets in the United States are small and have yet to reach scale, given that over 70% of fleets in the United States have ten or fewer full-size ZEBs.

Fuel cell electric buses (FCEBs), while still vastly outnumbered by battery-electric buses (BEBs), continued to gain traction, with deployments nearly doubling since the 2020 count.

Fuel cell electric buses (FCEBs), while still vastly outnumbered by battery-electric buses (BEBs), continued to gain traction, with adoption nearly doubling since the 2020 count. The footprint of small ZEBs has also expanded. Small ZEBs in the United States increased by 225 from the 2020 count, representing growth of 51%. Small ZEBs were purchased for the first time by transit agencies in several states, including Arizona, Colorado, Georgia, Indiana, Louisiana, Maryland, Minnesota, New Jersey, and Washington.

Momentum for ZEBs is expected to increase with the wide availability of funding. For example, President Biden signed the Infrastructure Investment and Jobs Act (IIJA) into law in November 2021, which offers \$5.25 billion in funding over five years to the FTA's Low or No Emission Bus Program (Low-No Program), which promises to expedite ZEB adoption in the United States. In August 2021, the Canadian government announced the creation of the Zero Emission Transit Fund, which is allocating \$2.75 billion on ZEBs over five years with a goal of deploying 5,000 ZEBs.



I. Introduction and Background

Since the creation of the Clean Air Act (CAA), the United States 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 such as nitrous oxide (NOx) directly into communities.

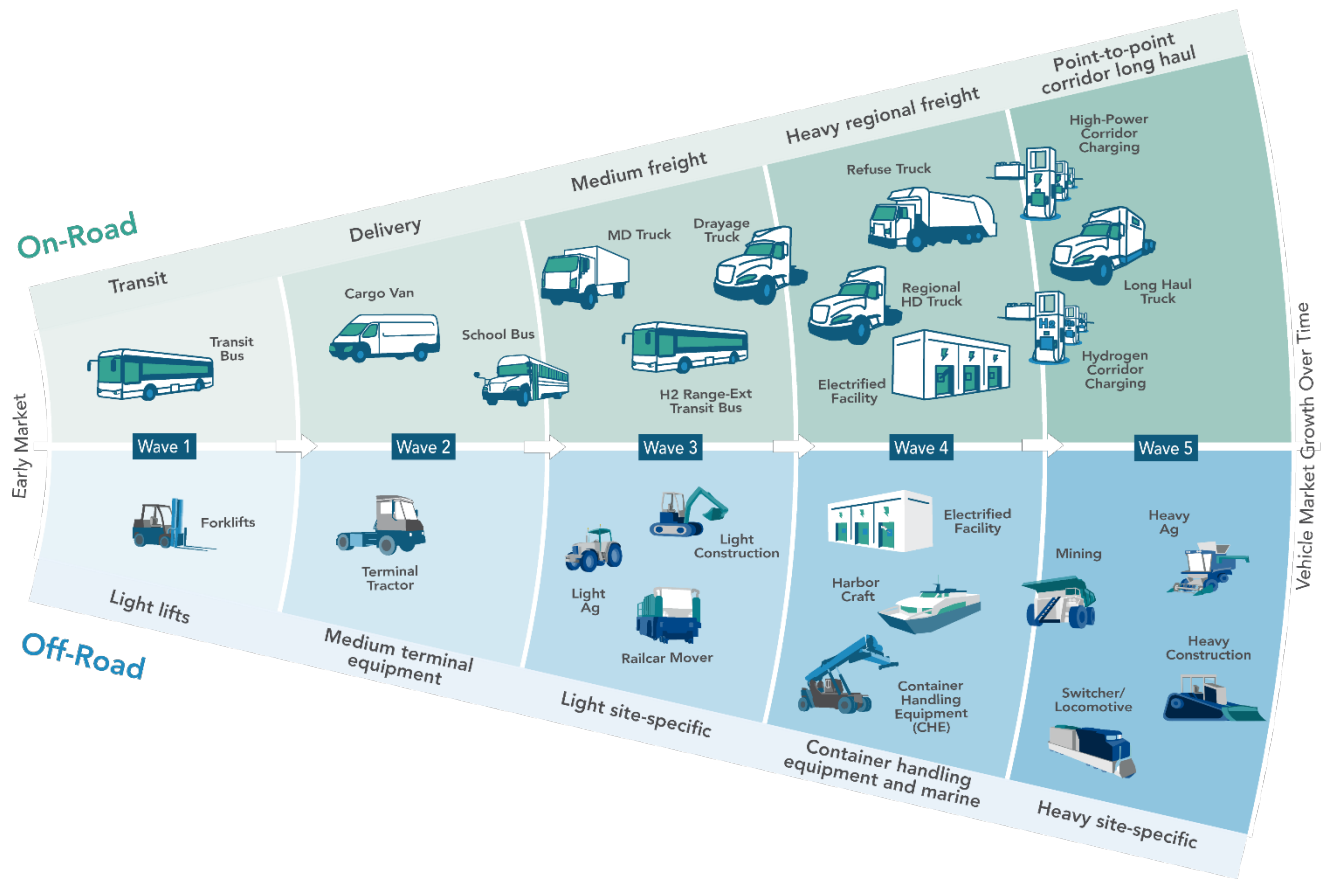
Between 2013 and 2021, the Federal Transit Administration (FTA) distributed over \$664 million for hybrids, battery-electric, and hydrogen fuel cell electric buses via the Low or No Emission Bus Program (Low-No Program). State-level grant programs, such as California's Transit and Intercity Rail Capital Program (TIRCP) and Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), 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, applications of ZEBs have steadily increased across North America. The number of ZEBs purchased by transit agencies, universities, and private entities has continued to grow as these organizations take advantage of the evolving battery-electric and fuel cell electric vehicle technology.

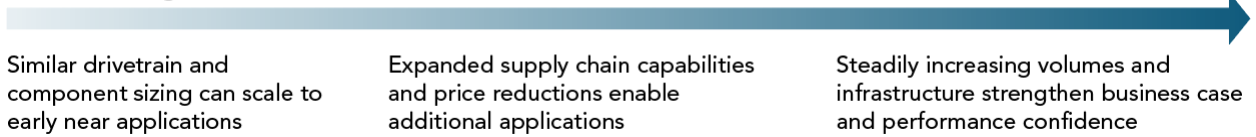
Quantifying this increase is a challenge first undertaken by CALSTART in 2018, with the release of the inaugural Zeroing in on Zero-Emission Buses report. CALSTART has updated this data annually in subsequent editions of Zeroing in on ZEBs, and the report has proved to be the definitive resource for those seeking up-to-date counts of ZEBs across the United States and now in Canada.

Tracking this data comprehensively throughout North America is an important exercise because it offers context to the United States and Canada's progress toward adopting this critical technology. As a broader view, **Figure 1** below presents the most recent 2021 update of the "beachhead model" visualization CALSTART developed in conjunction with the California Air Resources Board (CARB) to trace zero-emission technology adoption progress across different types of commercial vehicles, including buses.

Figure 1: The Zero-Emission Beachhead (CARB, 2021)



Market Progress Over Time



The data for this report is current as of September 2021 and has been gathered primarily through local, state, and federal award documents, press releases, phone interviews, and validated via sales information from bus manufacturers. As there is no centralized accounting of ZEBs, 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.

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.

This report quantifies the adoption of ZEBs in the United States and Canada. It is broken down by technology: battery-electric and hydrogen fuel cell electric. This report defines the adoption of transit ZEBs as those that have been funded, ordered, delivered, or deployed.

Stages of Transit Bus Deployments:

- **Funded:** Funding to support the procurement of the transit bus has been officially awarded.
- **Ordered:** The transit provider has officially placed an order for a ZEB.
- **Delivered:** The ZEB has been received by the transit provider and is being prepared to be placed into operational service.
- **Deployed:** The transit bus has been placed in operational service and is actively running in service.

II. U.S. Full-Size Transit ZEB Count

Full-size transit ZEBs (with “full-size” defined as a Class 7 or 8 bus that is 30 or more feet in length) nationally have grown to 3,533 buses on the road or on order, an increase of 27% since the 2020 report (see **Table 1**). The region of the country with the most buses was the West Coast (Washington, Oregon, and California), with well over a third in that region alone. California, a state where all new sales of transit buses must be zero-emission by 2030 according to the Innovative Clean Transit (ICT) regulation, had the highest number of ZEBs with 1,371.

Table 1: U.S. Full-Size Transit Zero-Emission Buses Year-Over-Year Growth

	2020	2021	Increase ('20 to '21)	Growth %
BEB	2703	3364	661	24%
FCEB	87	169	82	94%
Total ZEBs	2790	3533	743	27%
Deployed ZEBs	722	1287	565	78%

At this point in time, battery-electric buses (BEBs) are the most common form of ZEBs on the road compared to fuel cell electric buses (FCEBs). This can be attributed to a variety of factors including cost, infrastructure, and owner or operator preference. However, since numerous transit agencies have extended routes, many agencies are considering adopting FCEBs to meet their operational needs and reduce the total number of ZEBs adopted. One FCEB can meet the operational needs of two BEBs. As a result, it is likely that there will be an increase in FCEB adoption in the future.

Figure 2 provides a breakdown of the number of ZEBs by state across the United States. **Table 2** further disaggregates this data and provides a state-by-state breakdown of the number of BEBs and FCEBs adopted.

Figure 2: Full-Size Transit Zero-Emission Buses Funded, Ordered, Delivered, or Deployed Within the United States (Updated September 2021)

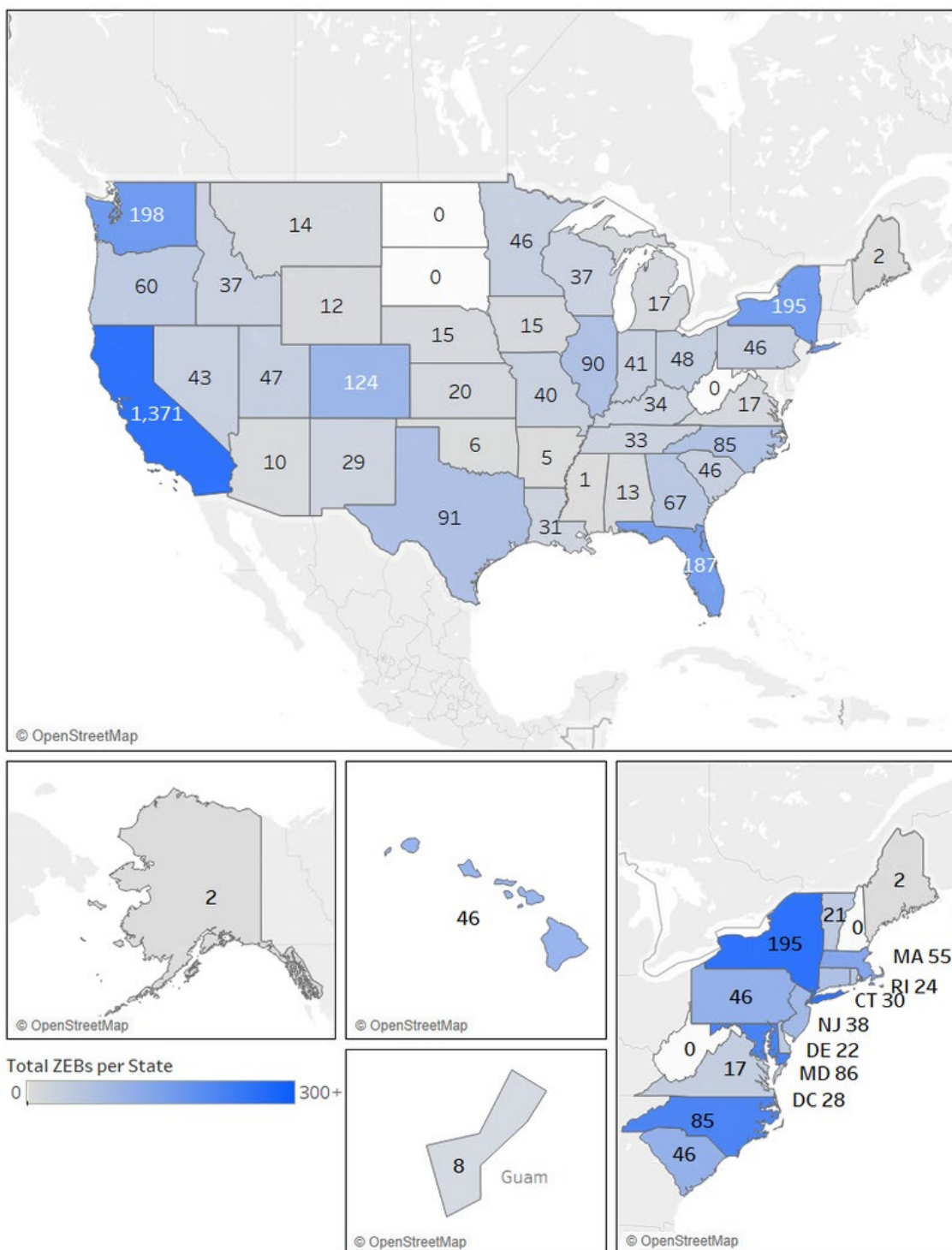


Table 2: State-By-State Full-Size Transit Zero-Emission Bus Distribution (Updated September 2021)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses	FTA Region
Alabama	AL	12	1	13	4
Alaska	AK	2	0	2	10
Arizona	AZ	10	0	10	9
Arkansas	AR	5	0	5	6
California	CA	1244	127	1371	9
Colorado	CO	124	0	124	8
Connecticut	CT	30	0	30	1
Delaware	DE	22	0	22	3
District of Columbia	DC	28	0	28	3
Florida	FL	187	0	187	4
Georgia	GA	67	0	67	4
Hawaii	HI	45	1	46	9
Idaho	ID	37	0	37	10
Illinois	IL	88	2	90	5
Indiana	IN	41	0	41	5
Iowa	IA	15	0	15	7
Kansas	KS	20	0	20	7
Kentucky	KY	34	0	34	4
Louisiana	LA	31	0	31	6
Maine	ME	2	0	2	1
Maryland	MD	86	0	86	3
Massachusetts	MA	52	3	55	1
Michigan	MI	15	2	17	5
Minnesota	MN	46	0	46	5
Mississippi	MS	1	0	1	4
Missouri	MO	40	0	40	7
Montana	MT	14	0	14	8
Nebraska	NE	15	0	15	7
Nevada	NV	41	2	43	9
New Hampshire	NH	0	0	0	1
New Jersey	NJ	38	0	38	2
New Mexico	NM	29	0	29	6
New York	NY	195	0	195	2
North Carolina	NC	85	0	85	4
North Dakota	ND	0	0	0	8
Ohio	OH	24	24	48	5
Oklahoma	OK	6	0	6	6
Oregon	OR	60	0	60	10
Pennsylvania	PA	46	0	46	3
Rhode Island	RI	24	0	24	1

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses	FTA Region
South Carolina	SC	46	0	46	4
South Dakota	SD	0	0	0	8
Tennessee	TN	33	0	33	4
Texas	TX	86	5	91	6
Utah	UT	47	0	47	8
Vermont	VT	21	0	21	1
Virginia	VA	17	0	17	3
Washington	WA	196	2	198	10
West Virginia	WV	0	0	0	3
Wisconsin	WI	37	0	37	5
Wyoming	WY	12	0	12	8
Guam	GU	8	0	8	9
Total		3364	169	3533	

Growth occurred in every FTA region in the past year. The region with the highest growth rate was Region 2, containing New York and New Jersey, with a growth rate of 138% compared to the 2020 count. New York saw a strong increase in full-size ZEB adoption going from 77 in 2020 to 195 in 2021, all of which are battery-electric. The region with the lowest growth rate was Region 10 in the Pacific Northwest and Alaska. For detailed information on growth per FTA region refer to Appendix B.

Figure 3 below illustrates the full-size ZEBs deployed by FTA region as of September 2021. Many states within Regions 4, 9, and 10 were early ZEB adopters and applied for funding in the first three years of the Low-No Program. With early awards going to states such as California, Florida, Kentucky, Oregon, and Washington, these states are now further along in the adoption process and their regions have more full-size ZEBs deployed today. However, a broader list of states has accelerated their adoption of full-size ZEBs and begun to close the gap, as demonstrated by the list in **Figure 4** of the ten states with the largest numerical increase in full-size ZEBs since the previous count.

Figure 3: Total Full-Size Zero-Emission Buses Deployed by FTA Region (Updated September 2021)

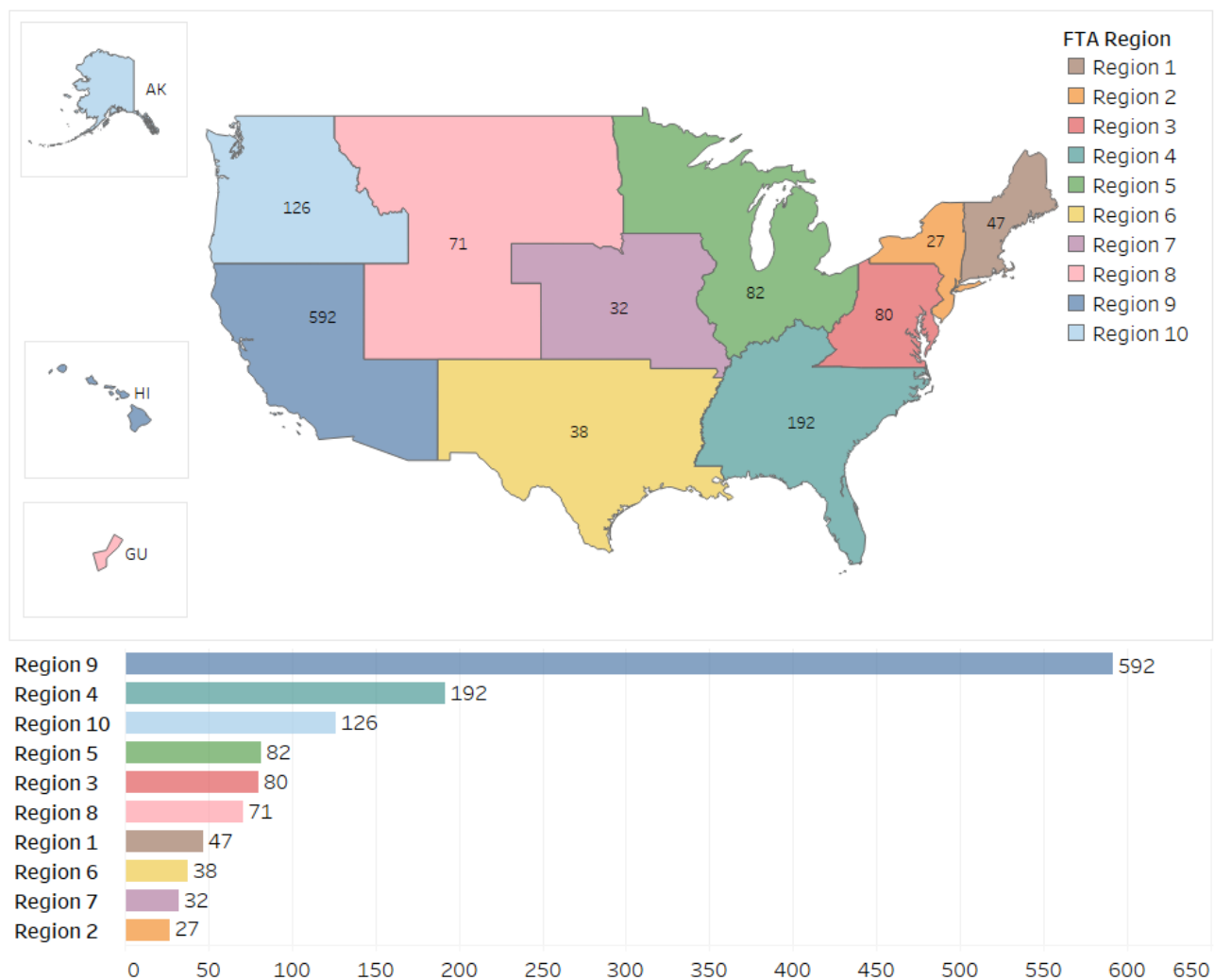
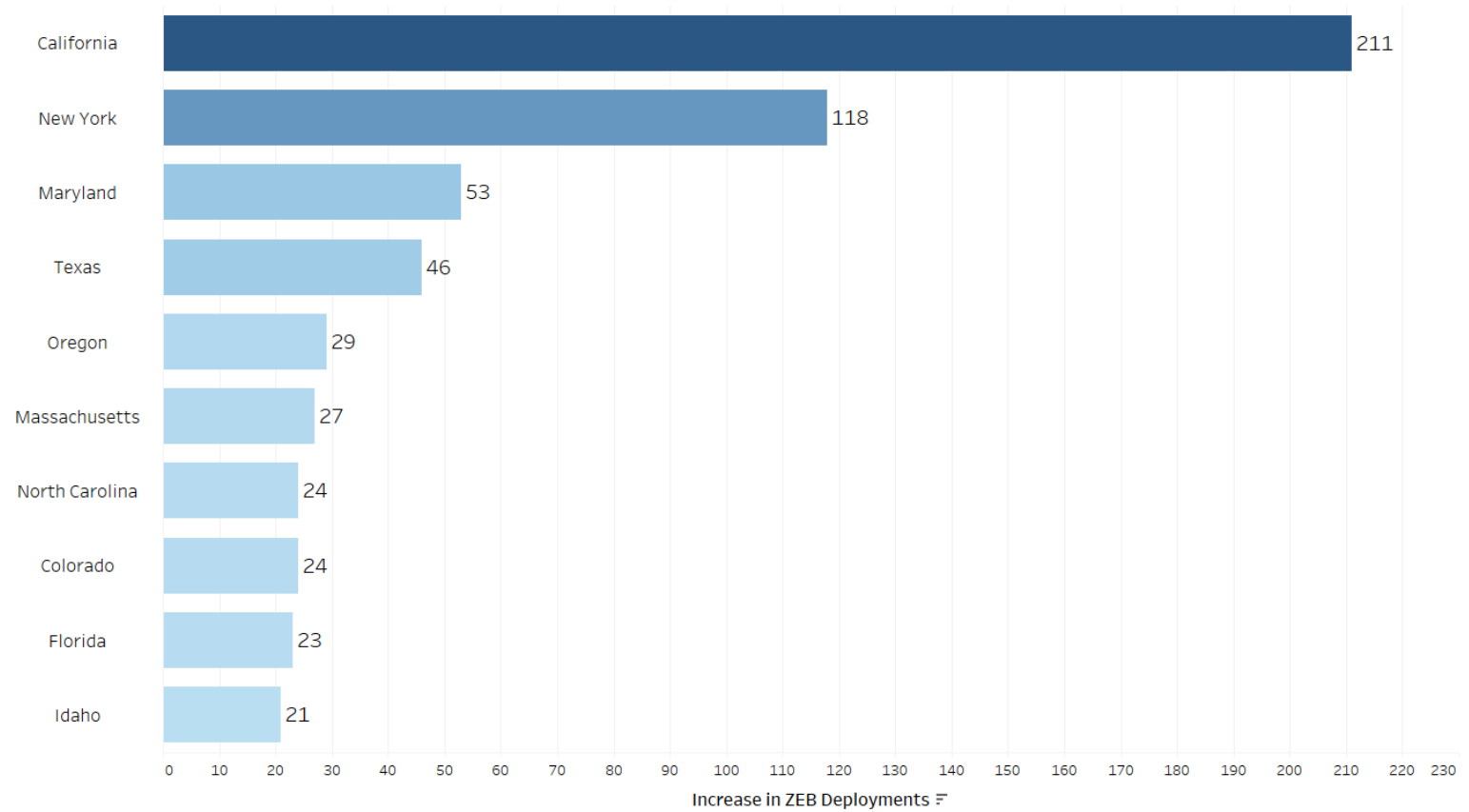


Figure 4: Top 10 States Increase in Full-Size Transit Zero-Emission Buses Compared to 2020

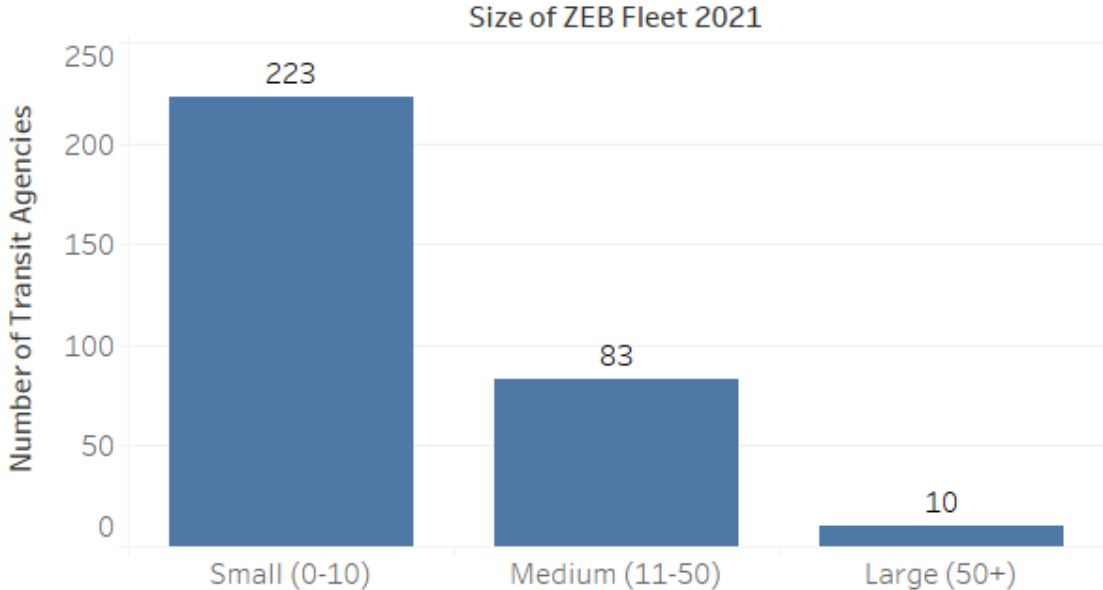


The median number of full-size ZEBs per transit property nationwide was six. The largest full-size ZEB fleet is the Los Angeles Department of Transportation (LADOT) with 160 buses, all of these being BEBs. The largest full-size FCEB fleet is the Alameda-Contra Costa Transit District (AC Transit), also in California, with 44 buses.

Over 70% of fleets in the United States have ten or fewer full-size ZEBs (see **Figure 5**). This demonstrates that most of the fleets are still operating a small number of ZEBs and have not yet reached scale. The distribution of ZEBs by fleet size is very similar to 2020's, which indicates that fleets are having difficulty getting to scale. While there has been an increase in the number of ZEBs across large transit fleets, most ZEB fleets remain small. Therefore, there is still a great need for more effort and resources to be devoted to helping smaller fleets overcome barriers to scaling.

California leads the nation with the most full-size ZEB deployments, as well as the most larger scale ZEB deployments. Despite this, California is on trend with the rest of the United States, as the majority of their transit agencies still have fewer than 10 ZEBs. This indicates that California will also need to provide resources to help scale up its smaller fleets.

Figure 5: Distribution of Full-Size Zero-Emission Bus Fleet Size in the United States



Fuel Cell Electric Buses (FCEBs)

Adoption of FCEBs in the United States nearly doubled since the 2020 count (see **Table 3**). California continues to lead the U.S. in the number of FCEBs adopted. However, Massachusetts, Texas, and Washington also had transit agencies that adopted new FCEBs in 2021. California and Ohio are the only states to have adopted more than 10 FCEBs. It is important to note that the interest in FCEBs is growing, as transit properties in Texas and Washington have purchased FCEBs for the first time.

Table 3: Fuel Cell Electric Buses with State Breakdown and U.S. Total, Year-Over-Year

State	2020 Totals	2021 Totals	Difference ('20 to '21)
Alabama	1	1	0
California	52	127	75
Hawaii	1	1	0
Illinois	2*	2	0
Massachusetts	1	3	2
Michigan	2	2	0
Nevada	2	2	0
Ohio	24	24	0
Texas	0	5	5
Washington	0	2	2
Total	87	169	82

*This number has been updated from the 2020 edition of this report.



III. U.S. Small ZEBs

Small ZEBs, those buses that are Class 3-6 and shorter than 30 feet, have also become an established technology in fleets. While most efforts to electrify fleets have focused on Class 7-8 transit buses, small buses compose a significant proportion of transit fleets' buses. According to the FTA's 2018 Annual Revenue Vehicle Inventory, transit fleets in the United States deployed around 183,760 small size buses.

Traditionally, transit agencies utilized these small buses to provide demand-response service for senior citizens and people with disabilities. Today, however, as transit agencies aim to boost ridership by providing the public with additional services such as on demand-response and first/last mile service, these offerings are prime for the small bus platform. The transition to ZEBs is not limited to the full-size bus counterpart and, as transit providers modernize their fleets and aim to make transit cleaner, more efficient, and dependable, the demand for small ZEBs is also growing across transit providers. Today, there are both small BEB and FCEB options available on the market.

As of September 2021, there are 661 small ZEBs adopted in the United States. This figure includes small ZEBs adopted by public transit agencies, private fleets, and airports. The count of small ZEBs in the United States increased by 225 from the 2020 count, representing growth of 51% (see **Table 4** for a breakdown of small ZEB year-over-year growth and **Table 5** for state-by-state small ZEB distribution). No new small FCEBs were purchased over the last year. The count of new small ZEBs purchased by public agencies increased by 129, representing 154% growth from 2020. Sixty-seven public agencies now have small ZEBs. Of the 67, 32 new public agencies purchased small ZEBs in 2021. Private companies, which include 14 new companies, purchased 77 new small ZEBs in 2021. This represents a 31% increase from 2020. Small buses adopted by airports and airport parking companies has increased from 100 in 2020 to 119 in 2021. This represents a 19% increase over the last year.

Table 4: U.S. Small Zero-Emission Buses Year-Over-Year Growth

Bus Type	2020	2021	Increase ('20 to '21)	Growth %
Public BEB	75	204	129	172%
Public FCEB	9	9	0	0%
Public Total	84	213	129	154%
Private BEB	252	329	77	31%
Private FCEB	0	0	0	0%
Private Total	252	329	77	31%
Airport BEB	100	119	19	19%
Airport FCEB	0	0	0	0%
Airport Total	100	119	19	19%
Total ZEBs	436	661	225	51%

Transit agencies in Arizona, Colorado, Georgia, Indiana, Louisiana, Maryland, Minnesota, New Jersey, and Washington purchased their first small ZEBs in 2021. Transit agencies have not reached scale for small ZEBs, with the largest deployment for a transit agency being 16 buses. Of the 67 transit agencies that have small ZEBs, 22 only have one bus. Out of these 67 transit agencies, 58 have four or fewer buses.

The vast majority of small ZEBs are battery-electric. Only nine small FCEBs total have been adopted in the United States. These small FCEBs are located in California and Ohio, which are the leading states for full-size transit FCEBs. All the small FCEBs that have been adopted were deployed by public agencies.

Table 5: State-By-State Small Zero-Emission Bus Distribution (Updated September 2021)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Arizona	AZ	2	0	2
California	CA	558	4	562
Colorado	CO	1	0	1
Connecticut	CT	1	0	1
Georgia	GA	3	0	3
Indiana	IN	2	0	2
Iowa	IA	14	0	14
Louisiana	LA	5	0	5
Maryland	MD	5	0	5
Michigan	MI	12	0	12
Minnesota	MN	4	0	4
Nevada	NV	1	0	1
New Jersey	NJ	7	0	7
Ohio	OH	11	5	16
Texas	TX	6	0	6
Vermont	VT	10	0	10
Washington	WA	4	0	4
Wisconsin	WI	6	0	6
Total		652	9	661



IV. Airport ZEBs

ZEBs have also become a common sight at airports. Numerous airports across the United States have adopted full-size and small ZEBs. These buses are typically used as “people movers” to transport airline passengers from parking lots to the airport terminal and back. Many private companies that operate off-site parking lots have also adopted ZEBs to transport airline passengers to and from the airport.

Based on this 2021 report, airports have adopted 131 full-size ZEBs (see **Table 6** below for state-by-state distribution). This is an increase of 34 new ZEBs, representing 35% growth from 2020. All these full-size ZEBs are battery-electric. In addition, 119 small ZEBs have been adopted by airports. This is an increase of 19 new small ZEBs in 2021, representing 19% growth from 2020. The total number of airport ZEBs in the U.S. is 250 buses, with 53 new buses adopted in 2021, representing an overall 27% growth from 2020. It is important to note that the airport small ZEBs reported here were also included in the overall small ZEBs count in the U.S. Small ZEBs section of this report.

Most airport ZEB deployments have been in California. This growth in airport ZEBs has been driven by California's Zero-Emission Airport Shuttle Regulation, which mandates that bus operators in 13 of the state's largest airports are required to fully transition to zero-emission shuttle buses by 2035. This has led to increased adoption of both small and full-size ZEBs at airports. This regulation applies to both the airports themselves and private buses that go to the airports. Today, the majority of airport full-size ZEBs are owned by the airports and the airport small ZEBs by the private airport parking companies. With this regulation in place, airports and private airport parking companies in California together are expected to deploy a growing number of ZEBs over the next decade.

Table 6: Airport Zero-Emission Buses State-By-State Distribution (Updated September 2021)

State		Full-Size Buses	Small Buses	Total
California	CA	53	101	154
Georgia	GA	2	0	2
Indiana	IN	9	2	11
Maryland	MD	8	0	8
Michigan	MI	2	0	2
Missouri	MO	4	0	4
New Jersey	NJ	12	0	12
New Mexico	NM	2	0	2
New York	NY	24	0	24
North Carolina	NC	14	0	14
Texas	TX	0	6	6
Total		131	119	250

V. Canadian ZEBs

In the last decade, Canada has procured ZEBs in cities across the country and in numbers expected to grow at a rapid pace with the country's recent federal investment in public transportation. Today, there are buses located in seven of its ten provinces stretching from British Columbia to Québec and Nova Scotia (see **Table 7**). The Canadian government has pledged to put 5,000 ZEBs, both transit and school buses, on the road 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. Transit agencies in Montréal and British Columbia have committed themselves to having completely zero-emission fleets by 2040.

As of September 2021, there are 606 full-size and small ZEBs in Canada. This includes 307 new full-size ZEBs since 2020. Of the total ZEBs in Canada, 596 of are BEBs and 10 are FCEBs. The data collected on the Canadian transit market was obtained by analyzing media reports and press releases. CALSTART also confirmed these figures with the Canadian Urban Transit Research & Innovation Consortium's (CUTRIC) ZEB Database™.¹

Table 7: Transit Zero-Emission Buses by Canadian Province (Updated September 2021)

Province	Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Alberta	61	0	61
British Columbia	17	0	17
Manitoba	4	0	4
New Brunswick	0	0	0
Newfoundland and Labrador	0	0	0
Nova Scotia	60	0	60
Ontario	413	10*	423
Prince Edward Island	0	0	0
Québec	40	0	40
Saskatchewan	1	0	1
Total	596	10*	606

*Announced as of the release of this report.

¹ It is important to note that CUTRIC has identified 621 ZEB purchases, which is 15 more than CALSTART's findings. These discrepancies are due to differences in data collection methodology and the definition of what constitutes a bus order.

Ontario, Canada's most populous province, is leading the country in ZEB adoption, with a total of 423 ZEBs. This figure is nearly seven times higher than that of Alberta and Nova Scotia with 61 and 60 ZEBs adopted, respectively. These ZEB adoption numbers countrywide are expected to grow at an increasing rate as Canada moves to achieve its net-zero emissions goal by 2050.



VI. U.S. Policy and Funding Sources

The United States government aims to transition to ZEBs to combat climate change and improve air quality. Both federal and state governments have introduced policies and funding sources to encourage this transition. These policies and funding sources have been instrumental in accelerating the adoption of ZEBs across the United States.

The main source of federal funding for ZEBs is the FTA's **Low or No Emission Program (Low-No Program)**. The Low-No Program aims to support transit fleets in the United States in their transition to the most energy efficient and lowest polluting transit vehicles available. The program, which had approximately \$182 million of funding available as of June 2021, is a competitive grant program that helps state and local government entities purchase or lease zero-emission and low-emission transit buses and pay for necessary supporting facilities and infrastructure as well as workforce training for maintenance staff and bus drivers. The Low-No Program has been a major catalyst for ZEB adoption and since its inception has funded 805 ZEBs. The **Infrastructure Investment and Jobs Act (IIJA)** signed into law by President Biden in November 2021 will increase Low-No funding. The IIJA provides \$5.25 billion in funding over five years to the FTA's Low-No program, which will be a great catalyst for accelerating the adoption of ZEBs.

Other federal programs like the **FTA Bus and Bus Facilities Grant** and the **Congestion Mitigation and Air Quality Improvement (CMAQ) Program** have also been used to fund ZEB purchases in the past. The newly introduced IIJA provides \$13.2 billion in funding for CMAQ over five years, which will open additional funding sources for ZEB adoption.

State-level policies and funding sources have also been introduced for ZEBs. California was an early proponent of ZEBs. The State of California's **Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)**, launched by CARB in 2009 and administered by CALSTART, underwrites point-of-purchase price reductions to fleets for clean commercial vehicles on a first-come, first-served basis. HVIP has been a major source of funding for ZEBs.

California also enacted the **Innovative Clean Transit (ICT) Regulation** in 2018. The ICT Regulation requires all public transit agencies to gradually transition their bus fleets to zero-emission technologies. The regulation applies to all transit agencies that own, operate, or lease buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds which covers all standard, articulated, over-the-road, double-decker, and cutaway buses. The regulation requires a percentage of new bus purchases to be ZEBs beginning in 2023. By 2029, 100% of all new bus purchases in California must be ZEBs. The goal of the ICT is for all transit agency fleets to be zero-

emission by 2040.

In addition to California, several other states have implemented programs and policies to support zero-emission vehicle adoption. The **New York Truck Voucher Incentive Program (NYTVIP)**, administered by the New York State Energy Research and Development Authority (NYSERDA), provides vouchers for fleets in New York to replace diesel commercial vehicles with battery-electric, hydrogen fuel cell electric, plug-in hybrid electric, conventional hybrid electric, compressed natural gas, or propane medium- and heavy-duty vehicles.

The **Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding** was signed in July 2020 by Washington, D.C. and 15 states (California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington). This effort intends to provide funding sources and incentives for the transportation industry to transition to zero-emission fleets.

Small ZEBs have a significant opportunity for growth once a few barriers to adoption are removed. One development that will accelerate the adoption of small ZEBs 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 request for proposal (RFP) or initiate the standard 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, transit agencies in California can acquire small buses through the purchasing contract led by the California Association for Coordinated Transportation and the Morongo Basin Transit Authority. Other states are following suit and developing statewide procurement contracts for small buses which will help accelerate deployments elsewhere in the United States. These contracts are expected to be released as soon as early 2022.

Another barrier is that, at present, there is only one small ZEB on the market that has passed the **FTA Bus Testing Program (Altoona Test)**. FTA funds can only be used on buses that have passed Altoona testing, so the more buses that eventually pass, the more options there will be for procurement.



VII. Canadian Policy and Funding Sources

The rapid growth of ZEBs in Canada has been driven by governmental policy. The Canadian government has made combating climate change a policy priority and recognizes that decarbonizing the transportation sector is vital to meeting its climate change goals. Canada aims to decarbonize all transportation sectors. However, public transit was identified as a key market segment for decarbonization. To this end, the Canadian government has enacted policies to encourage the adoption of ZEBs.

The Canadian government views the decarbonization of public transit as an important part of its climate change and economic development strategy. Canada is home to several ZEB manufacturers and aims to promote zero-emission public transportation as a part of its economic development strategy. In addition, Canada recognizes that deploying the vehicles is instrumental in reducing greenhouse gas emissions. As a result, Canada has enacted multiple policies to encourage the adoption of ZEBs.

The Canadian government began supporting ZEB deployments in the mid-2010s. Started by Natural Resources Canada, the **Electric Vehicle Infrastructure Development (EVID)** program received \$76 million in funding from the Canadian government under 2016 and 2017 budgets. EVID supports demonstrations of next-generation and innovative electric vehicle charging and hydrogen refueling infrastructure. Thus far, EVID has funded bus and infrastructure projects at the Toronto Transit Commission, Brampton Transit, and TransLink.

ZEBs were also identified by the Canadian government as a key area for combating climate change. Canada's **2020 Climate Change Plan** (titled "A Healthy Environment and a Healthy Economy: Canada's Strengthened Climate Plan to Create Jobs and Support People, Communities, and the Planet") aims for Canada to be net zero-emission by 2050. This plan aims for the electrification of public transit and calls for 5,000 ZEBs (both transit and school buses).²

The Canadian government provided financing mechanisms to support the 2020 Climate Change Plan's objective of deploying 5,000 ZEBs. Infrastructure Canada is the Canadian federal department responsible for public infrastructure. On February 10, 2021, Prime Minister Trudeau announced \$14.9 billion in funding for public transit. The **Zero Emission Transit Fund** was created to support public transit and school bus operators who are transitioning to zero-emission fleets. \$2.75

² It should be noted that the Canadian government has not been transparent regarding if buses using renewable natural gas (RNG) count as ZEBs under their definition.

billion of this funding will be spent on ZEBs over five years, starting in 2021, with a goal of deploying 5,000 ZEBs. Funding from the Zero Emission Transit Fund can also be used on infrastructure and site upgrades.

In addition, the Canadian Infrastructure Bank started a program to support the deployment of ZEBs. The **Canadian Infrastructure Bank (CIB)** is the crown corporation that works with government and private investors to attract private capital to infrastructure projects, including investing in public transit. CIB currently has a \$1.5 billion initiative (in addition to the \$14.9 billion from Infrastructure Canada) to deploy 4,000 ZEBs (transit and school) over three years.



References

- American Public Transportation Association (APTA). (2019). "Public Transit Leading in Transition to Clean Technology." Retrieved December 12, 2020, from https://www.apta.com/wp-content/uploads/Public_Transit_Leading_In_Transition_To_Clean_Technology.pdf
- California Air Resources Board. (2016). Retrieved December 4, 2020. "Transit Agency Survey Preliminary Results." ACT (Advanced Clean Trucks) Workgroup Meeting. Available at: https://ww3.arb.ca.gov/msprog/bus/transit_survey_summary.pdf
- California Air Resources Board. (2019, June 19). Retrieved December 8, 2020, from <https://ww2.arb.ca.gov/news/california-air-resources-board-approves-comprehensive-effort-clean-airport-shuttles>
- California Air Resources Board. (2020, July 15). Retrieved December 1, 2020, Available at: <https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification>
- California Air Resources Board. (2021). Appendix D: Long-Term Heavy-Duty Investment Strategy Including Fiscal Year 2021-22 Three-Year Recommendations for Low Carbon Transportation Investments. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2021-10/fy21-22_fundingplan_appendix_d.pdf
- 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>
- U.S. 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>
- U.S. 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
- Zero-Emission Vehicles: Our Platform - Canada. (2020). Retrieved December 8, 2020, from <https://liberal.ca/our-platform/zero-emission-vehicles/>

Appendix A: State-by-State Active U.S. Zero-Emission Transit Buses

Total = 1287

The following chart provides a state-by-state breakdown of the number of active zero-emission transit buses as of September 2021. Active buses are those that have been delivered and are in the physical possession of the transit agency.

Table A-1: State-by-State Full-Size Zero-Emission Buses Deployed in the United States

State		Total Zero-Emission Buses
Alabama	AL	12
Alaska	AK	2
Arizona	AZ	6
Arkansas	AR	0
California	CA	544
Colorado	CO	54
Connecticut	CT	10
Delaware	DE	22
District of Columbia	DC	14
Florida	FL	56
Georgia	GA	41
Hawaii	HI	4
Idaho	ID	18
Illinois	IL	21
Indiana	IN	21
Iowa	IA	2
Kansas	KS	0
Kentucky	KY	23
Louisiana	LA	28
Maine	ME	2
Maryland	MD	24
Massachusetts	MA	15
Michigan	MI	4
Minnesota	MN	18
Mississippi	MS	0
Missouri	MO	20

State		Total Zero-Emission Buses
Montana	MT	6
Nebraska	NE	10
Nevada	NV	38
New Hampshire	NH	0
New Jersey	NJ	0
New Mexico	NM	1
New York	NY	27
North Carolina	NC	24
North Dakota	ND	0
Ohio	OH	18
Oklahoma	OK	0
Oregon	OR	16
Pennsylvania	PA	3
Rhode Island	RI	0
South Carolina	SC	22
South Dakota	SD	0
Tennessee	TN	14
Texas	TX	9
Utah	UT	3
Vermont	VT	20
Virginia	VA	17
Washington	WA	90
West Virginia	WV	0
Wisconsin	WI	0
Wyoming	WY	8
Total		1287

Appendix B: Regional Breakdown of ZEB Distribution by FTA Region

The following charts list the transit agencies that have active ZEB deployments as of September 2021.

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

Total Buses = 130 (71% Growth from 2020)

		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Connecticut	CT	30	0	30
Maine	ME	0	0	0
Massachusetts	MA	52	3	55
New Hampshire	NH	0	0	0
Rhode Island	RI	24	0	24
Vermont	VT	21	0	21
Total		127	3	130

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

Total Buses = 233 (138% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
New Jersey	NJ	38	0	38
New York	NY	195	0	195
Total		233	0	233

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

Total Buses = 199 (52% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Delaware	DE	22	0	22
District of Columbia	DC	28	0	28
Maryland	MD	86	0	86
Pennsylvania	PA	46	0	46
Virginia	VA	17	0	17
West Virginia	WV	0	0	0
Total		199	0	199

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

Total Buses = 466 (61% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Alabama	AL	12	1	13
Florida	FL	187	0	187
Georgia	GA	67	0	67
Kentucky	KY	34	0	34
Mississippi	MS	1	0	1
South Carolina	SC	85	0	85
North Carolina	NC	46	0	46
Tennessee	TN	33	0	33
Total		465	1	466

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

Total Buses = 279 (6% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Illinois	IL	88	2	90
Indiana	IN	41	0	41
Michigan	MI	15	2	17
Minnesota	MN	46	0	46
Ohio	OH	24	24	48
Wisconsin	WI	37	0	37
Total		251	28	279

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

Total Buses = 162 (62% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Arkansas	AR	5	0	5
Louisiana	LA	31	0	31
New Mexico	NM	29	0	29
Oklahoma	OK	6	0	6
Texas	TX	86	5	91
Total		157	5	162

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

Total Buses = 90 (23% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Iowa	IA	15	0	15
Kansas	KS	20	0	20
Missouri	MO	40	0	40
Nebraska	NE	15	0	15
Total		90	0	90

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

Total Buses = 197 (27% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Colorado	CO	124	0	124
Montana	MT	14	0	14
North Dakota	ND	0	0	0
South Dakota	SD	0	0	0
Utah	UT	47	0	47
Wyoming	WY	12	0	12
Total		197	0	197

Table B-9: FTA Region 9 (Without California) State-By-State Zero-Emission Bus Distribution

Total Buses = 107 (23% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Arizona	AZ	10	0	10
Hawaii	HI	45	1	46
Nevada	NV	41	2	43
Guam	GU	8	0	8
Total		104	3	107

Table B-10: FTA California (Region 9) State-By-State Zero-Emission Bus Distribution

Total Buses = 1371 (18% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
California	CA	1244	127	1371

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

Total Buses = 297 (<1% Growth from 2020)

State		Battery-Electric Buses	Fuel Cell Buses	Total Zero-Emission Buses
Alaska	AK	2	0	2
Idaho	ID	37	0	37
Oregon	OR	60	0	60
Washington	WA	196	2	198
Total		295	2	297