



# Bus Procurement Cost Analysis

## Summary

This analysis examines the cost of buses for transit agencies across the county. Specifically, to observe the variation of bus cost for propulsion type with a focus on Zero Emission Buses (ZEB).

Data was compiled from three data sources:

1. FTA Bus and Low- and No-Emission Grant Awards press release (federally funded, nationwide data)
2. TIRCP project data (state-funded, California only data)
3. DGS usage report for all procurements from California agencies purchasing from New Flyer and Portera Inc.

The initial dataset included nearly 300 projects. It was reduced to 126 projects after applying criteria to exclude non-bus related work. Projects involving the construction of new facilities, training programs, or the procurement of non-bus items such as trains and ferries were excluded. The final dataset comprised only projects focused on bus procurement. The remaining projects, on average, procured 13.0 buses and cost \$9108598.0.

These projects were aggregated against propulsion type and bus size type, and categorized by ZEB and non-ZEB.

### **ZEB projects are categorized into the following propulsion types:**

- zero-emission (not specified)
- electric (not specified)
- battery electric bus (BEB)
- fuel cell electric bus (FCEB)

### **Non-ZEB projects include the following propulsion types:**

- compressed natural gas (CNG)
- ethanol
- low-emission (hybrid, propane)
- diesel
- gas

These projects were broken down and visualized in the sections below.

# Charts and Tables

The following visuals display the kinds of variations to bus cost that transit agencies face.

## Overall summary totals by data soruce

|   | source      | number_of_projects | bus_count | total_cost   | cost_per_bus |
|---|-------------|--------------------|-----------|--------------|--------------|
| 0 | dgs         | 36.0               | 236.0     | 2.501129e+08 | 1059800      |
| 1 | fta         | 81.0               | 1195.0    | 7.103200e+08 | 594410       |
| 2 | tircp       | 9.0                | 233.0     | 1.872505e+08 | 803650       |
| 3 | grand total | 126.0              | 1664.0    | 1.147683e+09 | 689713       |

Broken down further, we can observe the type of ZEB projects by data source.

|        |                                   | number_of_projects | bus_count | total_cost  | cost_per_bus |
|--------|-----------------------------------|--------------------|-----------|-------------|--------------|
| source | prop_type                         |                    |           |             |              |
| dgs    | BEB                               | 30                 | 163.0     | 167232489.0 | 1025966      |
|        | FCEB                              | 6                  | 73.0      | 82880364.0  | 1135347      |
| fta    | BEB                               | 8                  | 95.0      | 113363089.0 | 1193295      |
|        | FCEB                              | 1                  | 23.0      | 29330243.0  | 1275227      |
|        | electric (not specified)          | 3                  | 27.0      | 35421858.0  | 1311920      |
|        | zero-emission bus (not specified) | 2                  | 39.0      | 29369656.0  | 753068       |
| tircp  | electric (not specified)          | 2                  | 36.0      | 46678000.0  | 1296611      |
|        | zero-emission bus (not specified) | 5                  | 143.0     | 128156513.0 | 896199       |

## Summary of cost by ZEB propulsion types

| prop_type                         | number_of_projects | bus_count | total_cost | cost_per_bus |
|-----------------------------------|--------------------|-----------|------------|--------------|
| BEB                               | 38                 | 258       | 280595578  | 1087579      |
| FCEB                              | 7                  | 96        | 112210607  | 1168860      |
| electric (not specified)          | 5                  | 63        | 82099858   | 1303172      |
| zero-emission bus (not specified) | 7                  | 182       | 157526169  | 865528       |
| grand total                       | 57                 | 599       | 632432212  | 1055813      |

### Summary of cost by non-ZEB propulsion types \*

| prop_type              | number_of_projects | bus_count | total_cost | cost_per_bus |
|------------------------|--------------------|-----------|------------|--------------|
| CNG                    | 17                 | 252       | 176637661  | 700943       |
| low emission (hybrid)  | 27                 | 326       | 254868983  | 781806       |
| low emission (propane) | 5                  | 53        | 15354392   | 289705       |
| grand total            | 49                 | 631       | 446861036  | 708179       |

\*The remaining buses did not specify a propulsion type

| prop_type     | number_of_projects | bus_count | total_cost | cost_per_bus |
|---------------|--------------------|-----------|------------|--------------|
| not specified | 19                 | 395       | 63700147   | 161266       |

## Which agencies had the highest and lowest ZEB cost per bus?

### Max cost\_per\_bus

| transit_agency                       | prop_type | total_cost     | bus_count | cost_per_bus |
|--------------------------------------|-----------|----------------|-----------|--------------|
| University of California - San Diego | BEB       | 4134000.000000 | 2.000000  | 2067000      |

### Min cost\_per\_bus

| transit_agency  | prop_type | total_cost    | bus_count | cost_per_bus |
|---|-----------|---------------|-----------|--------------|
| California Department of Transportation, on behalf of Morongo Basin Transit Authority | BEB       | 131168.000000 | 1.000000  | 131168       |

University of San Diego did not any information regarding their project. Morongo Basin Transit Authority explained their project saying "The California Department of Transportation, on behalf of the Morongo Basin Transit Authority, will receive funding to buy a battery-electric bus to replace an older vehicle. This project will improve air quality, safety, reliability and state of good repair in the San Bernadino County service area. ".

Neither agencies describe the specifics of their buses which may explain the differences in cost per bus

# Which agencies procured the most and least amount of ZEBs?

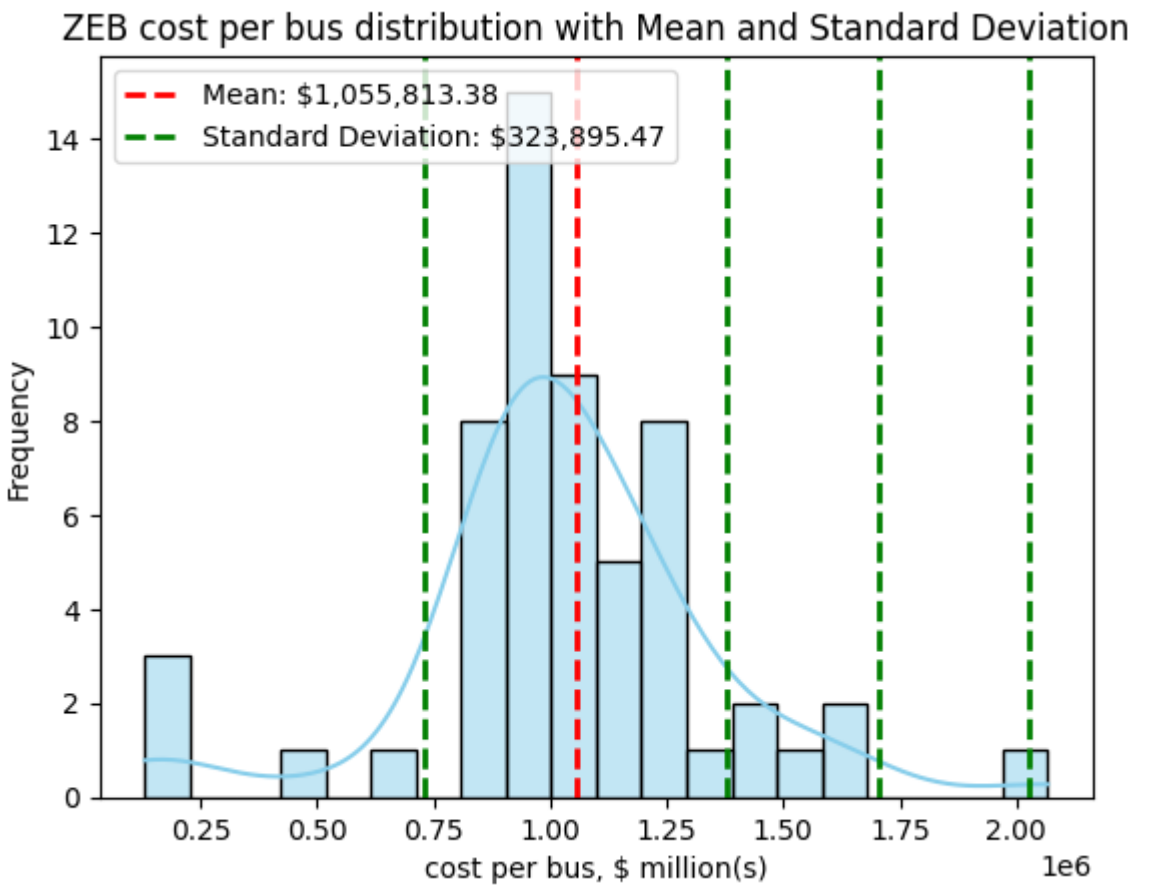
Max bus\_count

| transit_agency               | prop_type                         | total_cost       | bus_count  | cost_per_bus |
|------------------------------|-----------------------------------|------------------|------------|--------------|
| City of Los Angeles (LA DOT) | zero-emission bus (not specified) | 102790000.000000 | 112.000000 | 917767       |

Min bus\_count

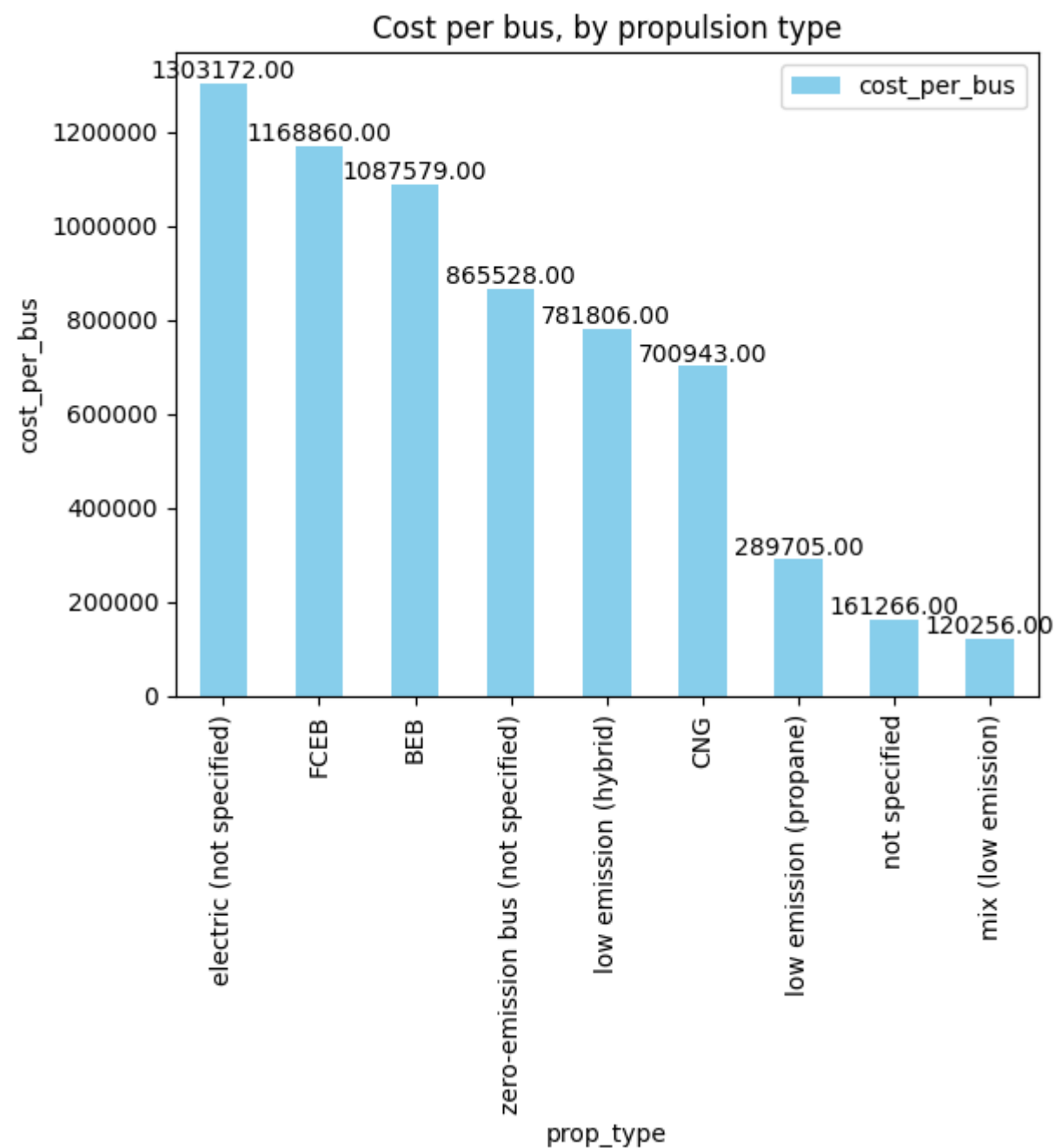
| transit_agency  | prop_type | total_cost    | bus_count | cost_per_bus |
|---|-----------|---------------|-----------|--------------|
| California Department of Transportation, on behalf of Morongo Basin Transit Authority | BEB       | 131168.000000 | 1.000000  | 131168       |
| SLO TRANSIT (SAN LUIS OBISPO, CA)   | BEB       | 847214.000000 | 1.000000  | 847214       |
| City of San Luis Obispo   | BEB       | 859270.000000 | 1.000000  | 859270       |

# What is the distribution of ZEB cost?



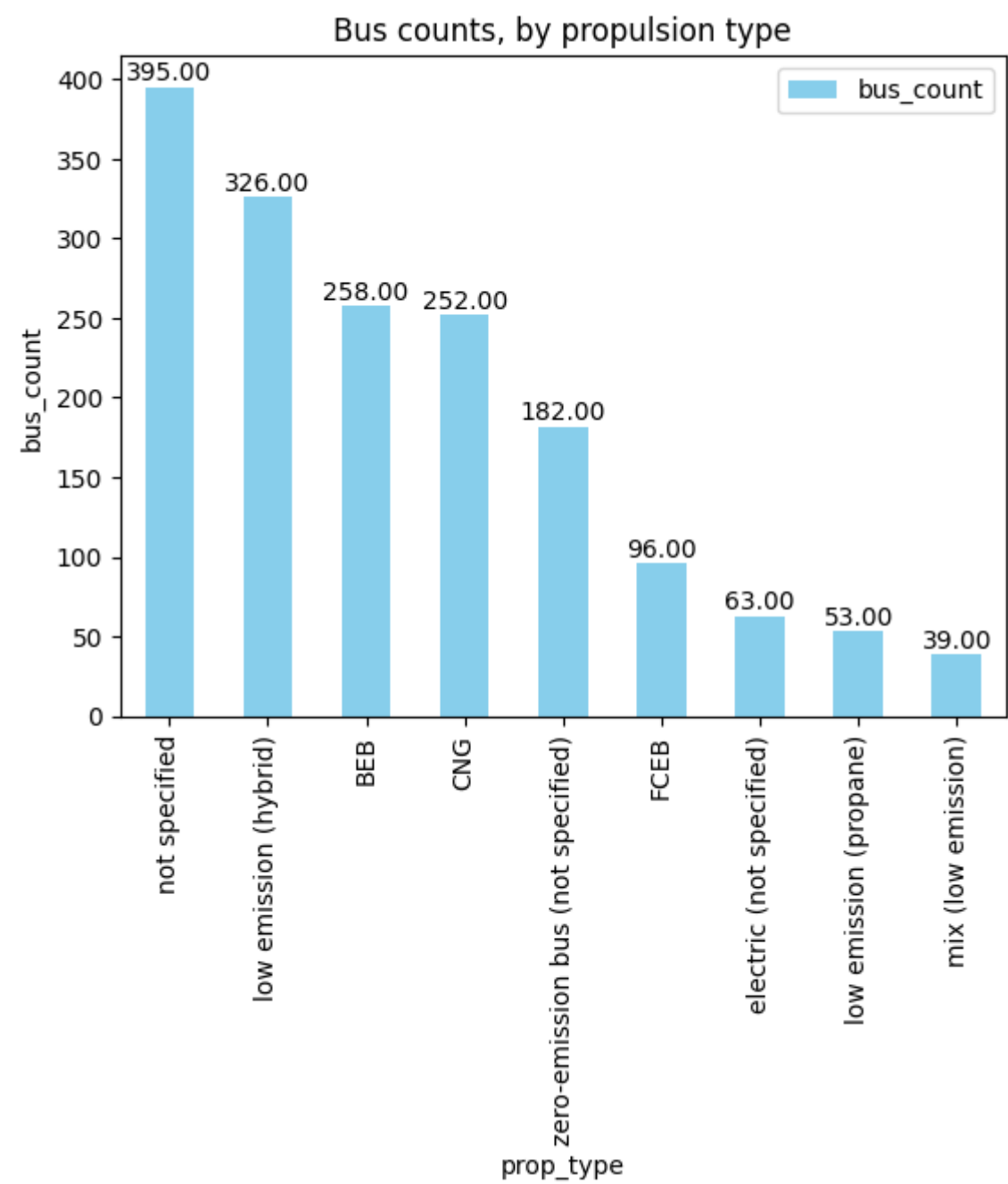
This distribution show the ZEB cost floating around ~\$1,000,000 , with only a few instances extending past +/- 1 standard deviation. As shown earlier, the lowest cost per ZEB bus was about ~\$500,000 . However it should be noted that the propulsion type for this instance did not specify exactly which type of ZEB was procured (BEB, FCEB, or otherwise). The highest cost per ZEB was about ~\$2,000,000 for BEB.

What is the cost per bus compared against all propulsion types?



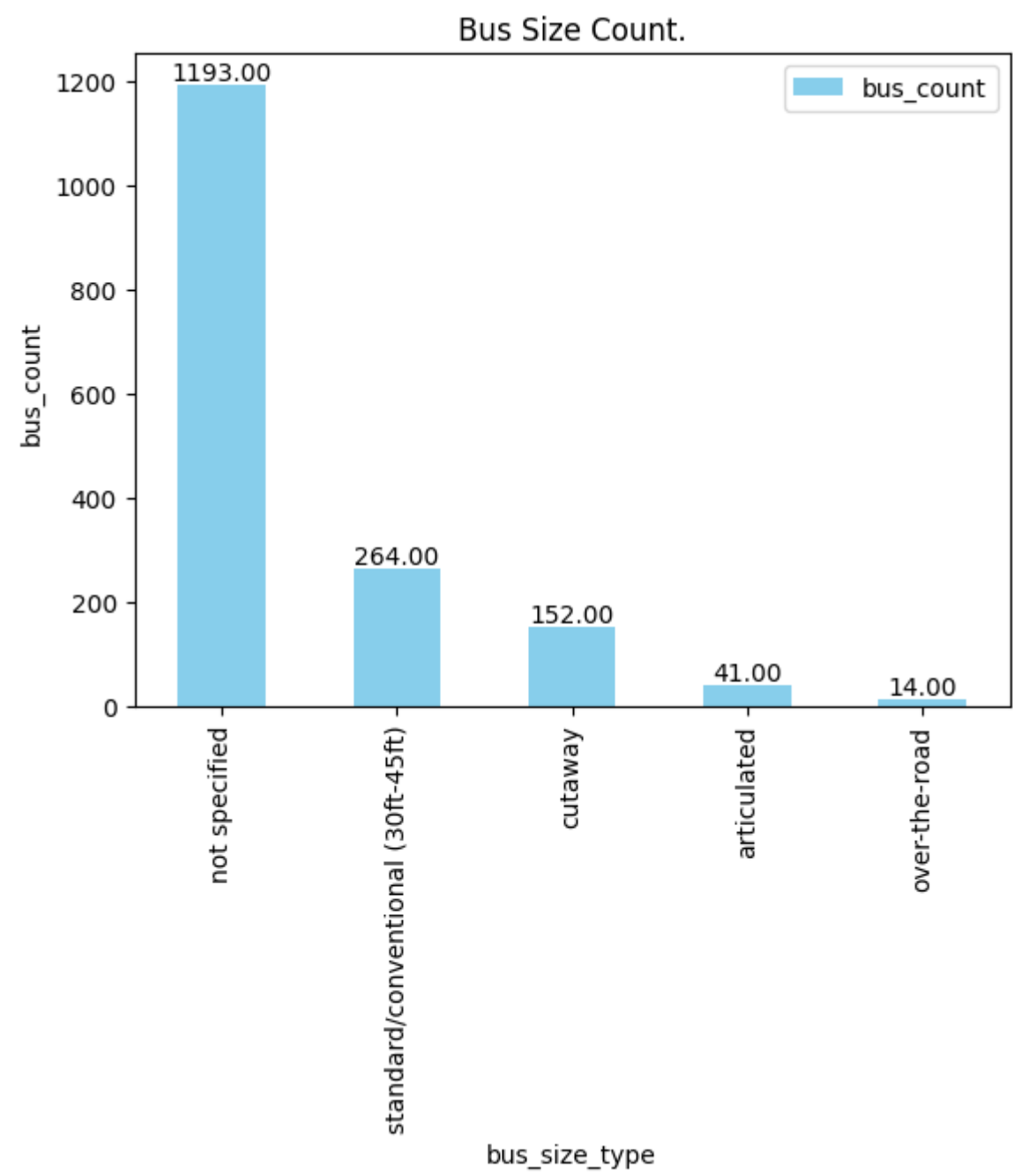
None

What is the total bus counts compared to each propulsion type?



None

What is the total bus counts compared to each bus size category?





Unfortunately, many of the projects did not specify any information indicating a bus size type. However we can breakdown other categories that provide a little more insight to bus sizes.

## What is the breakdown of ZEB Propulsion Type and Bus Size Category?

|                                   |                                   | bus_count | total_cost  | cost_per_bus |
|-----------------------------------|-----------------------------------|-----------|-------------|--------------|
| prop_type                         | bus_size_type                     |           |             |              |
| BEB                               | articulated                       | 12.0      | 18759576.0  | 1563298      |
|                                   | not specified                     | 95.0      | 113363089.0 | 1193295      |
|                                   | standard/conventional (30ft-45ft) | 151.0     | 148472913.0 | 983264       |
| FCEB                              | not specified                     | 23.0      | 29330243.0  | 1275227      |
|                                   | standard/conventional (30ft-45ft) | 73.0      | 82880364.0  | 1135347      |
| electric (not specified)          | articulated                       | 29.0      | 39478000.0  | 1361310      |
|                                   | not specified                     | 34.0      | 42621858.0  | 1253584      |
| zero-emission bus (not specified) | not specified                     | 182.0     | 157526169.0 | 865528       |

We can observe in this table that, when aggregated against propulsion type, the standard bus size (30ft-45ft) is the most common size category for ZEBs

## Conclusion

Based on these findings, The average cost of a ZEB, throughout the US, is ~\$1,000,000, roughly twice the price of a conventional, non-ZEB. The most commonly procured BEBs and FCEBs are the standard 30ft-45ft category, costing ~\$980,000 and ~\$110,000 respectively. The variance in cost depends mainly on the options the Transit Agencies chooses. Highly optioned/customized buses contribute to higher cost. Unfortunately, analyzing the cost of configurable options is outside the scope of data provided.