# Estimated cost of replacing half of all U.S. school buses with electric school buses in ten years

*Updated on May 4, 2021*

## Assumptions and sources

Note: This calculation is not intended to be used as a proposed program design; rather, it is an estimate of the potential costs of a federal program to subsidize and incentivize the replacement of half of the nation's fossil-fuel powered buses with electric models.

### Capital cost subsidies

- For simplicity, the subsidy for school buses is based on the incremental cost of Type C electric compared to Type C diesel buses. Approximately 72% of school buses sold in the U.S. are Type C. [Source: School Bus Fleet Magazine, 2020]
- Electric school bus (ESB) prices vary, but the statewide contracts published by the New York State Office of General Services are a useful guide. For both Thomas Built and Blue Bird Type C models, the cost differential is approximately $240,000. That is the difference between the electric and the diesel bus. An additional $20,000 is added to account for variations in price by contract, region, or additional bus options (such as chair lifts). [Source: NY OGS Contract for School Buses, 2021]
- It is expected that costs for ESB technology will decrease as production increases, but it is impossible to predict how quickly. Prices for lithium-ion batteries have decreased approximately 18% per year over 2010 - 2018 [Source: Bloomberg New Energy Finance data], so that is used as a prediction. This may be aggressive, but perhaps not overly, because current prices likely incorporate R&D costs—costs which would be recovered quickly under a program of this magnitude and higher volume of buses being demanded. Potential future revenue/savings from vehicle to grid, vehicle to building, and other applications of bi-directional charging technology (together, V2X) and pollution fees are not included.
- The number of buses funded per year starts at today's estimated production capacity and increases to include 100% of replaced buses by the year 2026. There are an estimated 500,000 school buses in use in the U.S., with an approximate lifetime of 15 years. [Source: School Bus Fleet, 2021] Multiple top manufacturers have stated they have the capacity to produce approximately 1,000 electric school buses per year, so current capacity is likely 3,000-4,000. We make the assumption that production can be approximately doubled from Year 1 and Year 2, and from Year 2 to Year 3, with smaller increases in subsequent years. Barriers to rapid deployment include the need for extensive electrical upgrades, school district and private fleet operator capacity and interest, and range limitations. A majority of school bus duty cycles can be fulfilled by existing ESB models and battery technology is improving rapidly.
- Revenues for V2X are not included because they are not currently available in most places. It is expected that VGI projects will become available unevenly in different locations as the technology and regulations advance. The USPIRG in their Accelerating the Transition to Electric School Buses, 2021 reports potential market values of up to $15,000 per bus per year in one pilot. There are a few V2X pilots being deployed in the U.S., Clean Energy Works is working with Roanoke Electric in a pilot for North Carolina.
- Costs for charging infrastructure can vary widely, depending particularly on whether Level 2 AC charging or DC Fast Charging (DCFC) is used. Both types of charging station—also known as electric vehicle service equipment or EVSE—can potentially provide V2X services, but it is commonly understood that higher-power DCFC has greater V2X potential, so the price reflects the estimated costs of purchasing and installing DCFC EVSE.

### Deployment assistance

- Recognizing that different school districts and private fleet operators have varying levels of technical capacity and resources, additional funds for school bus fleets to deploy ESBs are provided. These funds could be used by districts or contractors to hire or contract for technical assistance in deploying ESBs.

### Workforce development

- Training should be provided for school bus drivers, and extensive training will be needed for school bus technicians to train in the new technology, and for manufacturing workers to work on EV components and assembly. Further research is needed to determine the amount of funding needed for such training, but this calculation assumes a significant level of funding for critical training programs.

### V2X pilots and demos

- A federal ESB funding program could potentially include funding to promote V2X pilot and demonstration projects. Some of these programs will pay for themselves and generate revenue; other programs may provide climate or disaster resilience and may not generate revenue but could serve important public purposes. Funded costs could include additional infrastructure, interconnection costs, technology consultants, and reports.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | **TOTALS** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2021-2031** |
| Bus cost subsidy (incremental cost) | $260,000 | $213,200 | $174,824 | $143,356 | $117,552 | $96,392 | $79,042 | $64,814 | $53,148 | $43,581 | |
| Charging infrastructure (full cost) | $40,000 | $32,800 | $26,896 | $22,055 | $18,085 | $14,830 | $12,160 | $9,971 | $8,177 | $6,705 | |
| Annual price reductions | | 18% | 18% | 18% | 18% | 18% | 18% | 18% | 18% | 18% | |
| Number of units | 3,500 | 7,500 | 13,500 | 21,500 | 31,000 | 33,000 | 35,000 | 35,000 | 35,000 | 35,000 | |
| Bus expenditures | $910,000,000 | $1,599,000,000 | $2,360,124,000 | $3,082,147,120 | $3,644,101,386 | $3,180,947,855 | $2,766,460,710 | $2,268,497,782 | $1,860,168,181 | $1,525,337,909 | **$23,196,784,942** |
| Charging inf. exp. | $140,000,000 | $246,000,000 | $363,096,000 | $474,176,480 | $560,630,982 | $489,376,593 | $425,609,340 | $348,999,659 | $286,179,720 | $234,667,371 | **$3,568,736,145** |
| Deployment assistance per bus | $10,000 | $10,000 | $10,000 | $7,500 | $7,500 | $7,500 | $5,000 | $5,000 | $5,000 | $2,500 | |
| Deployment assistance | $35,000,000 | $75,000,000 | $135,000,000 | $161,250,000 | $232,500,000 | $247,500,000 | $175,000,000 | $175,000,000 | $175,000,000 | $87,500,000 | **$1,498,750,000** |
| Workforce development per bus | $12,500 | $10,000 | $10,000 | $7,500 | $7,500 | $5,000 | $5,000 | $5,000 | $5,000 | $2,500 | |
| Workforce development | $43,750,000 | $75,000,000 | $135,000,000 | $161,250,000 | $232,500,000 | $165,000,000 | $175,000,000 | $175,000,000 | $175,000,000 | $87,500,000 | **$1,425,000,000** |
| Number VGI pilots/demos | 15 | 20 | 15 | 15 | 10 | 5 | 5 | 5 | 5 | 5 | **100** |
| Avg. funding per VGI project | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 | |
| V2G / resilience pilots/research | $2,250,000 | $3,000,000 | $2,250,000 | $2,250,000 | $1,500,000 | $750,000 | $750,000 | $750,000 | $750,000 | $750,000 | **$15,000,000** |
| Annual expenditures | **$1,131,000,000** | **$1,998,000,000** | **$2,995,470,000** | **$3,881,073,600** | **$4,671,232,368** | **$4,083,574,448** | **$3,542,820,050** | **$2,968,247,441** | **$2,497,097,902** | **$1,935,755,279** | **$29,704,271,087** |

| | |
|---|---|
| Total expenditures | **$29,704,271,087** |
| Total units replaced | **250,000** |
| % of all U.S. buses replaced | **50.00%** |